SCIENCE INFORMATION NOTES

A collection of articles on scientific and technological matters, research policies, science and society, higher learning etc.

APRIL 1980

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April 1980 issue of Science Information Notes, is being sent to you. It has now been prepared in quarto size format. We have tried to improve these notes in the light of various suggestions received from our distinguished Fellows.

This issue also includes FOUR brief accounts of "Research in Progress" sent by some of the Fellows. Similar information from other Fellows of the Academy would be most welcome and will be included in subsequent issues of the information notes.

We would be grateful for your suggestions and contributions for enriching the contents of the Science Information Notes.

J N Nanda

Dr. J. N. Nanda
Executive Secretary

INDIAN NATIONAL SCIENCE ACADEMY
SCIENCE INFORMATION NOTES
APRIL - 1980
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Current Research Activities

(Write up of the work being carried out in the National Research Centre on Dairy Chemistry, National Dairy Research Centre, Karnal)

By Prof. N.C. Ganguli, F.N.A.,
National Research Centre on Dairy Chemistry,
National Dairy Research Institute,
Karnal-132001. (Haryana)

Our group is engaged in particular areas of milk protein research for correlating structure and function of these macromolecules. In the manufacture of certain milk products, proteins of milk like casein and its fractions and lactoglobulins play a very vital role in ascertaining the quality of the end products. For this purpose, studies on the conformation of milk protein molecules using circular dichroism and its relationship with the primary structure in the formation of casein micelles, interaction with constituents in milk environment simulating the conditions of milk technology are being investigated. The peptide regions responsible for eliciting function of the molecule in micelle formation and chymosin action are being studied using solid-phase peptide synthesis. By reorganising the milk constituents, a new infant food from buffalo milk named 'Humanized buffalo milk' has been formulated.

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Current Research Activities

Differences in the structural organization of the two subunits of Escherichia coli ribosome

(Write-up of the work being carried out in the Department of Biochemistry, Banaras Hindu University, Varanasi)

By Prof. B.K. Burma, F.N.A.,

Ribosome is one of the complex organelles of the cell which is the site of protein synthesis. Earlier it was believed that ribosome acts as an inert platform for the assembly of amino acids into proteins but recent evidences have indicated that all the components of the ribosome are involved at different stages of protein synthesis. The ribosome of the bacterium Escherichia coli is composed of two different subunits, the large one containing 34 different proteins and 2 RNA molecules while the smaller one contains 21 different proteins and 1 RNA molecule. Extensive work is being carried out in the Molecular Biology Unit of the Department of Biochemistry of the Institute of Medical Sciences, Banaras Hindu University, Varanasi on the differences in the structural organisation of the two ribosomal subunits. It has been shown by enzymatic studies, spectrophotometric as well as spectrofluorometric measurements as well as immunological approaches that the large ribosome has an RNA-rich and protein-poor region which makes it behave differently from the smaller subunit in various respects. This region appears to be a fingerlike projection (stalk) as identified by immune electron microscopy in Lake's laboratory in California, U.S.A.

Biology is truly a land of unlimited possibilities. We may expect it to give us the most surprising information and we cannot guess what answers it will return in a few dozen years to the questions we have put to it. They may be of a kind which will blow away the whole of our artificial structure of hypothesis.

S. Freud, Beyond the Pleasure Principle

(Source: Book entitled 'Science and Human Life By J.A.V. Butler'. 1957, p.28)

Current Research Activities

Cytophysiological Researches on the Avian Adrenal Medulla

By Prof. Ashok Ghosh, F.N.A.,
Department of Zoology,
University of Calcutta,
Calcutta.

Avians stand out among warm-blooded vertebrates in possessing an adrenal gland in which interrenal and medullary tissues are completely intermingled. Based on histochemical cytology and biochemical assay, avian species are found to contain Epinephrine and Norepinephrine in various concentrations reflecting a phylogenetic diversity in hormonal secretion. Whether the two catechol hormones originate from one or two cell types in majority of birds still remains an open question. Characteristic mucopolysaccharides have been found to be associated with the bird adrenal medulla.

Researches have definitely revealed the dynamic behaviour of both the avian catechol hormones. Thus, in birds norepinephrine appears to be an equally effective blood glucose - enhancing hormone when compared to epinephrine. Parallel efficacy of both chatecholamines as pressor hormones has also been noted in this vertebrate group.

Our investigation emphasizes the important physiological role played by the adrenal medulla in avian reproduction and migration. The heat-protective action of norepinephrine and the regulatory role of ascorbic acid in epinephrine biosynthesis are also items of interest and the information adds to our knowledge on avian adrenomedullary functions.

"Scientists should conduct scientific research in relation to problems of the day. They should consider the basic approach to the problem which, in my opinion, is temper for peace."

Pt. Jawaharlal Nehru
At Fortythird Session 1956
Indian Science Congress

Current Research Activities

Skirted Granular Piles

(Write-up of the work being carried out at Central Building Research Institute, Roorkee (U.P.)

Although stone columns are becoming popular for reinforcing clay deposits, their use in non-cohesive soils is not so common, as recourse has always been taken to techniques like vibro-floatation, compaction piling, use of explosive charges. This Institute has developed another technique called skirted granular piles which provides economical and technically feasible foundation in such soils. It involves construction of skirted granular piles for reinforcing weak soils to improve strength and limit settlements.

The field studies on stress-deformation behaviour of a loose to medium, non-cohesive soil deposits reinforced with both plain and skirted granular pile have shown that the soils are capable of sustaining high loads for single or groups of 3 and 4 piles. The improvement was found to be about 280 percent for 3 pile group and 375 percent for 4 pile group. Besides, the ultimate load was found to be mobilised at a deformation of about 20 percent of the pile dia, whereas the transition of stress-deformation behaviour from elastic to elastoplastic occurs at a deformation of about 7.5 percent of pile diameter.

Non-cohesive sub-soils reinforced with granular pile can provide economical foundations for buildings as well as for other industrial structures. In addition these may be useful in reducing liquefaction potential in fine-to-medium saturated cohesionless soils. If skirted in groups the retrieval type of foundations could be of great advantage for foundations for oil rigs. Also buildings under distress due to excessive differential settlement could be strengthened by skirting to arrest further deformations.

"These eminent men and women should not confine themselves to the deliberations of the Conference alone but should talk to our youth and make them feel the international quality of science. Men and women of science must inculcate a spirit of international outlook in the minds of India's youth, who would have to bear the burden of future administration of India."

Pt. Jawaharlal Nehru
At Thirtyseventh Session 1950
Indian Science Congress

The peptide hit parade

LRF has become the object of intensely competitive research because of its potential aphrodisiac effects. One prominent researcher claims that a company hired to analyze blood samples of impotent men given LRF, stole the data for its own use.

Beta-endorphin seems to help the body turn off its response to pain much as morphine does. There is some evidence that acupuncture anesthesia and pain-relief placebos may work by bringing beta-endorphin or a similar chemical into action.

Enkephalins, the smallest endorphins, take their name from the Greek words for "in the head." What they are doing there no one knows for sure, but they seem to share some of the pain-relieving potential of beta-endorphin.

Factor S, which has been studied by Harvard researcher John Pappenheimer and his colleagues, may be a sleep-promoting peptide. Isolated from the brain fluid of goats and sheep that were forced to stay awake, this substance increase sleeping time when given to rabbits.

Bombesin, first discovered in the skin of the frog Bombina bombina, can turn rats from warm-blooded to cold-blooded animals when injected into their brains. The chemical also seems to turn on the sympathetic nervous system, which regulates basic functions like the stress response and blood pressure, and may help determine whether calories in food are used to produce heat or stored as fat. Thus, speculates Marvin Brown at the Salk Institute, bombesin could form the basis of an antiobesity drug.

Somatostatin seems to have the opposite effect from bombesin in the brain; it generally turns off the sympathetic nervous system. Drugs based on this peptide may therefore be useful in lowering blood pressure.

Substance P is involved in transmitting pain signals from the body to the brain. If various technical problems can be overcome, "an antagonist to Substance P could be the ideal anesthetic," according to physiologist Roger Nicoll at the University of California, San Francisco.

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Bradykinin may play a similar role in pain transmission. Very low doses of this peptide cause intense pain when injected. It may be the most painful substance known.

Angiotensin, a peptide that regulates fluid excretion in the kidneys, makes experimental animals drink copiously when injected into their brains. It may also be used to develop new anti-hypertensive drugs.

Cholecystokinin, originally discovered in the intestine, appears highly concentrated in the brain's most evolved region, the cerebral cortex. Some researchers have suggested that cholecystokinin normally carries the brain signal to stop eating, and that a deficiency of the peptide may lead to obesity. Rosalyn Yalow, at Veterans Administration Medical Center, Bronx, has found that the peptide is much less prevalent in the brain of a strain of genetically obese mice than in normal mice.

Neurotensin shows a powerful analgesic effect in animal experiments, and a drug company is now testing a number of drugs based on this peptide to see if they are also effective pain-killers.

ACTH, a peptide manufactured by the pituitary gland, is also found in nerve cells in the brain. Over the past decade several studies have shown that people can learn and remember better when they are given a small fragment of an ACTH molecule by injection. Dutch researcher David de Wied has found that the peptides vasopressin and oxytocin can also aid learning and memory. The results are intriguing, but since most chemical models of learning and memory have proved false, many researchers view these experiments with caution.

(Science 80, 1, 1(Nov./Dec. 1979) p. 33)

Indian Science fails to meet basic needs of the country

By A. Vaidyanathan

Anil Agarwal's article on 'Indian Science' brought out several interesting points. However, he has failed to raise some basic issues. For example, while India is spending money for highly sophisticated technology such as space and nuclear research, science and technology, even in their crudest form, have not reached the mass of Indian villagers, for whom hunger and starvation are an every-day reality. Indian science policy was not able to prevent the Bihar famine and recent floods and cyclone disasters. It has, however, led to the creation of bureaucratic research institutions and to the mushroom growth of CSIR research laboratories. It is, in fact, only the continuation of a policy which existed in colonial times. Research institutions such as CSIR, the Atomic Energy Commission and the Defence Research Laboratories are prestige institutions. Most Government bodies are bureaucratic institutions controlled by a few individuals.

India has built up a sizeable infrastructure for research and industry, but technology for manufacturing common household goods, such as dry batteries or condensed milk, still has to be imported. Indian scientists have given no thought to the need of basic technology in their country. Despite the green revolution, agricultural wages have declined or stagnated in real terms. The population of cities is increasing annually by about 5% because of the influx of the impoverished from the countryside.

The present attempts to formulate a science policy do not account well enough for education. The type of science education given in Indian universities is imported from western countries, and has no relevance to Indian society. A large amount of money has been spent on universities, research institutions and engineering colleges. At the moment there are more than 3,000,000 students in universities, more than one third of them being science students. By the end of 1979 the figure will rise to more than 5,000,000.

Indian universities have become factories for producing graduates. But why expand like this when there are not enough jobs for those who already have degrees? Recently there were more than 40,000 applicants for 40 vacancies; and for a few vacancies in nationalised banks there were so many applications that they had to be collected in vanloads. Unemployment among graduates runs at more than 30% and in large cities the situation is really alarming. Even though most universities provide undergraduate science and technology courses, the standard is pretty bad. That of science teaching in private colleges (which are affiliated to the universities but run on a commercial basis) is far below normal. Most teachers do not have sufficient qualifications to

Contd..---- 8/-

teach at this level and laboratory facilities are very bad.

What is the point of producing graduates who do not come up to reasonable standards and who do not serve any useful purpose in Indian society? Instead, science education should aim to teach basic ideas on a mass scale. The standard of science teaching in schools must be improved before talking about undergraduate study. Most schools in small towns have to be content with spirit lamps, and experiments are not devised to make maximum use of existing facilities.

It would, for example, be a good idea to use experimental kits (like those devised by the Open University) which could be stored in small towns, each store forming the nucleus of a science centre. Mobile service units, manned by trained teachers and operating from those centres, could go to villages and explain to children, with the help of simple experiments, the concepts of basic science and technology. So far Indian science education has no relevance to Indian society.

Although a lot of noise has been made in favour of appropriate technology, it has failed to make any impact on rural development in India. This is because appropriate technology by definition is an indigeneous self-generating process arising as a response to the economic and social needs of various forms and levels of society instigated and initiated by the users of existing technology. Such technologies will not work satisfactorily until farmers have experienced the benefits of communal production and projects and are thus able to design and operate such equipment. Unless the desire for change and for an appreciably higher standard of living takes place in the peasant communities (which is happening among Punjab and Hariyana farmers) new techniques will not be accepted or exploited fully.

At present the keystone of Indian science education is elitism and personal achievement rather than social responsibility; centralisation rather than dispersion; urban rather than rural aesthetic development. What is important and essential is that basic science and technology should be oriented towards the needs of the Indian society. Above all, the masses must be carried with technological development and not isolated from it.

(Nature, 283, 5742 (Jan. 3, 1980) p.10)

Science: Our Common Heritage
By Kenneth E. Boulding

(Extracts)

...Illusions can last a very long time, especially when they are of the sort that cannot be tested, but there is always a probability that illusions that can be tested will eventually be found out and relabeled as error...

...The knowledge structure in the human brain consists not only of images of "fact," but also of a complex structure of preferences and valuations at least at three levels: preferences, or first-order valuations; ethics, which is an evaluation of preference, especially those of other people; and ethical critique, which is an evaluation of ethics...

Science is a fuzzy set within the field of human knowledge...

...Such cultural mutations take place fundamentally as a result of ethical mutations, that is changes in the human value system which are then transmitted through the culture that they created from one generation to the next...

...There is a constant potential tension between the scientific community, with its peculiar ethic, and the social environment in which it finds itself and which supports it...

...If this image changes unfavorably, the niche will begin to close. This could happen either because of the spread of illusions about science or, what may be more dangerous, the spread of adverse realistic images...

...: It is important, therefore, to try to detect possible illusions about science.
...Experimental science is appropriate for the study of systems that have events of high probability, stable parameters, and isolable subsystems...
...Measurement and logic are "general" methods found in all sciences, in varying qualities...
...Measurement is important in testing, especially as we move beyond the human scale...

... Quantification for the most part is a prosthetic device of the human mind...
...Fortunately, the principle that topological structures can be mapped into a set of numbers enables us to perceive relationships in the topological structures of the real world...

...One can then classify the images, theories, and paradigms of the scientific community according to the degree to which they are truisms...

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Many of the "great laws" of science are empirical truisms...
...If we translate negative entropy as "potential," we can state it in the form that, if anything happens, it is because there is a potential for it happening, and after it has happened that potential has been used up...

Empirical regularities sometimes lead to the discovery of theoretical necessities, as happened in celestial mechanics...
...Without logical necessity, empirical regularity is little better than superstition...

...The impact of science on the economy and on technology came surprisingly late...

After 1860, however, we get an extraordinary period, in which the know-what of science is increasingly translated into the know-how of technology...
...The niche for the automobile, however, was created by the oil industry...

...The enormous increase in agricultural productivity on which a great deal of our development depends would have been impossible without scientific genetics...

...The intense fear of recombinant DNA, the fear that the biological sciences could let loose previously unknown plagues which will decimate the human race is perhaps only 99 percent irrational and the 1.0 percent is worth worrying about...

Undoubtedly, the greatest social cost of science has been its use in the development of weapons and the means of destruction...
...Just as gunpowder made the medieval castle indefensible, so the nuclear missile has destroyed the unconditional viability of the national state...

Nevertheless, science is also the greatest hope of the human race...
...The increased political repression which disorder so often brings about is itself a threat to science. We saw this in the destruction of genetics by Stalin, the crippling of science in China during the Cultural Revolution, and what looks like the total destruction of whatever scientific community there was in Cambodia...

...The scientific community itself must evolve. It needs a renewed sense of its mission and its ethic...
...It needs to develop within it a discipline of "normative science" which will take the study and critique of human valuations seriously...

(Science, 207, 4433(February 22, 1980) pp.831-36)

Distributing poverty more fairly
By Joe Hanlon

"When a country like mine prevents a few individuals from exploiting others, or tries to give priority to rural areas, we are doing only one thing. We are distributing poverty more fairly." This comment was made by Julius Nyerere, president of Tanzania, which, with an annual average income per head of $190, has a lot of poverty to distribute.

Nyerere was speaking in July at WCARRD, the World Conference on Agrarian Reform and Rural Development. But this has been a year for UN development conferences, with UNCTAD (trade and development) in the spring and UNCSTD (science and technology for development) in August. And his remarks are equally applicable to all of them. As are his views of UNCTAD: "another example of the determination of the rich to remain rich, and to go on getting richer at the expense of the poor."

All three conferences have had the ritual promises about the industralised nations helping the poor to develop. But these fine words cannot mask the fundamental overriding point- the terms of trade for the main agricultural exports of the developing countries have steadily worsened over the past two decades. For example, in 1960 the rubber producing countries could import six tractors in exchange for 25 tonnes of raw rubber. In 1965 it was down to 3.5 tractors. By 1975 only two tractors could be bought with the same amount of raw rubber.

This is not an isolated example - it is the norm. Yet, as FAO (the UN Food and Agriculture Organisation) pointed out in a recent report, the poorest countries "were hit by sharply rising costs of fertilisers, manufactured goods, and basic foodstuffs at a time when the real prices for their exports were falling." Thus, despite conference promises, the poor countries must run harder just to stay in place.

Science and technology are vital to development. But far from providing the solution to the worsening terms of trade, science and technology are caught up in it. Scientists like to think that they are producing knowledge for the general store, and that it will help everyone; knowledge is said to be the great leveller. Yet worsening terms of trade mean less foreign exchange. Which in turn means that the department (or even the university) subscriptions to Nature or New Scientist, already shared by dozens of scientists, cannot be renewed. Even apparently freely available knowledge is, it seems, not so freely available. And vital equipment and chemicals needed by local researchers to apply general knowledge cannot be bought for lack of money.

Some would argue that rather than just being caught in the widening gap, science and technology are in fact the cause of it. Consider energy. It was our application of science and technology to the control of water, coal, and oil that gave our development such a big boost. Solar energy is the major resource in the developing countries, which tend to be nearer the Equator. But who controls solar energy technology?

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The developed nations and the multinational corporations. And they are using existing patent legislation to ensure that the developing countries don't get a look in.

Patent rights and control of technology are central to UNCTAD and UNCSTD, and the developed nations and the multinational corporations are not giving way. Instead, the multinationals are continuing, as Nyerere put it, "their manipulations to increase the wealth of the already rich at the expense of the desperately poor".

The North-South gap is getting wider-in direct proportion to the frequency of UN conferences intended to reverse this trend. To those in the developing nations, the scientists and technologists of the developed nations are increasingly seen as a vital support for widening the gap. Far from creating knowledge to benefit all mankind, they are seen as creating knowledge to help the few exploit the many.

It may be that just as scientists and engineers took the lead in development in the North, so they must take the lead in development in the South. But this time, the lead cannot just be technical - it must be political as well.

(New Scientist, 83, 1170, (August 30, 1979), pp.672-73)

A hydraulic push for solar energy
(Extract)

The seasonal variation of solar power in Europe could be overcome by combining a system of solar heating with another "natural" energy source that also has seasonal fluctuations but whose cycle is out of phase with that of solar energy. One possibility is a hydro-photovoltaic plant. At a meeting of the UK branch of the International Solar Energy Society last Friday, Guy Smekens, of the Belgian group Energies Nouvelles et Environement, described such a scheme for generating "peak power" - electricity when demand is highest, and its value is, therefore, greatest. Smekens wants to use the fact that solar energy is at a maximum in summer whereas hydraulic energy peaks in winter.

A big disadvantage of any energy system that is not always reliably available is that there has to be a back-up power supply to take over when there is no sunlight, for example. Thus solar energy systems will save only on fuel costs, and not on the capital cost of building conventional systems - this money still has to be spent. Fuel savings alone rarely make "renewable" energy technologies economically competitive. A combined hydro-photovoltaic plant could, says Smekens, be reliable enough to remove the need for standby supplies.

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And such a system could, says Smekens, be economically competitive at solar-cell prices significantly higher than those required to make photovoltaic solar energy cost effective on its own. At the moment solar cells now cost between $5 and $15 per peak watt. The US Department of Energy has a programme whose goal is to cut this to $0.15 to $0.5 per peak watt by 1990 - this is the sort of price at which solar cells would begin to compete with conventional electricity supplies in much of Europe. Smekens believes that his approach could be economically feasible at solar cell costs of the order of $0.8 to $1.3 per peak watt. The US DOE hopes to achieve this cost level around the mid-1980s.

(New Scientist, 84, 1175 (October 4, 1979), p. 6)

Analyses of historical data suggest Sun is shrinking

(Extract)

At high moon on every clear day since 1750, astronomers at the Royal Greenwich Observatory have been measuring the diameter of the Sun. The quantity is a by-product of a more fundamental measurement, which is to determine the precise position of the center of the Sun with respect to the stars. To do this, they record the time at which each limb of the Sun crosses the fixed meridian wire of an instrument. From the same data one can then calculate the horizontal solar diameter from the known rotation rate of the Earth.

By analyzing data from Greenwich in the period 1836-1953, John A. Eddy (Harvard - Smithsonian Center for Astrophysics and High Altitude Observatory in Boulder) and Aram A. Boornazian (a mathematician with S. Ross and Co. in Boston) have found evidence that the Sun has been contracting about 0.1% century during that time, corresponding to a shrinkage of about 5 feet/hour. And digging deep into historical records, Eddy has found 400-year-old eclipse observations that are consistent with such a shrinkage. Eddy and Boornazian reported their results at the American Astronomical Society meeting held in Wellesley, Massachusetts in June.

(Physics Today, 32, 9 (September, 1979) pp.17-21)

Bee poison is sweetness itself

Bee colonies that survive the winter may suffer what beekeepers call "spring dwinding" which may result in the death of even strong colonies. Allen Sylvester of the Bee Breeding Stock Center Laboratory in Los Angeles suggests that a hitherto unsuspected cause of spring dwindling may be the types of sugar that occur in the nectar of some flowers that the bees visit (Journal of Economic Entomology, Vol. 72, p.81).

Most nectars are dilute impure sucrose solutions, but some contain lactose or galactose both known to be toxic to bees. To find out if bees can detect these toxic sugars, Sylvester caged batches of young bees, and offered each batch either straight sucrose syrup, or sucrose syrup laced with lactose or with galactose, both of which are known to be toxic to bees. Bees can store any syrup taken but not consumed.

Inevitably, some of the bees died, but even allowing for the casualties, Sylvester found that the bees took much less of the laced syrup than the straight sucrose. While the experiment demonstrates nothing about bees' preferences, it does show that in conditions of plenty, they can avoid the toxic sugars. However, when honey stores are low, foraging bees may be less choosy. By gathering toxic nectar they may accelerate the colony's death.

(New Scientist, 83, 1165 (July 26, 1979), p.288)

Flying fast

The Garrett Corporation of California has claimed a radically new approach to the construction of flywheel-driven vehicles (BI 1 534 393). A flywheel helping to power a car or bus is an old idea. It offers the obvious advantage that energy gained during downhill travel or braking can be stored to power subsequent acceleration. But there are problems in building a wheel that stores sufficient energy to be of practical value.

To be an efficient store, the wheel must either be very heavy or rotate very fast. In either case there is a risk that the wheel will distort and disintegrate. The proposed new approach is to make a lightweight wheel in such a way that its shape varies according to its speed of rotation. The ideal shape for rapid revolution is only obtained when the wheel is rotating very fast.

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An aluminium "spider", similar to the steering wheel of a car, carries a number of rims, each looking like metal tyres. These rims are nested one over the other. At rest, the rims are in the shape of a slightly rounded square. But at high speed, centrifugal force forces them into the ideal circular shape.

The inventors argue that the energy stored in a flywheel, proportional to the mass of the rim, is proportional to the square of the rotational speed. So their novel approach, which enables a light wheel to reach a very high speed without distortion and disintegration, should be more effective than past attempts at increasing the wheel mass without attending to other design factors.

(New Scientist, 81, 1148(March 29, 1979). p.1036)

Science, Technology, Development, and Environment: The Emerging Synthesis
By Mostafa Kamal Tolba
(Extracts)

...The arms race is claiming colossal financial resources - US$ 40 millions per hour - which could be effectively utilized to mobilize scientific and technological 'breakthroughs' to solve development problems.

The arms race is also a drain on available human resources: some half-a-million highly trained scientists and technicians and more than 70 million others are used to produce means of destruction rather than means of production. These highly-qualified and -trained people are alienated from the real values and needs of their society.

The international community should seriously search for, and urgently agree on, means of releasing most of these resources which are currently squandered on the arms race. These, if ensured as additional resources with due continuation, could bring a major change of perspective, in the form of new scientific and technological solutions, to persistent and potentially explosive problems of development.

(Environmental Conservation, 6, 4(Winter 1979) pp. 253-55)

Climate and Economic Development
By Asit K. Biswas
(Extract)

Climate is an important parameter that should be considered in any theories of economic development, especially in the tropics and sub-tropics. The Physical, social, economic, cultural and institutional conditions are very different in the tropics to those in temperate zones. Development plans for the tropical countries must consider these special characteristics, and then devise ways to maximize each country's assets and minimize its liabilities on a long-term sustainable basis.

(The Ecologist, 9, 6(Sept./Oct. 1979) p. 188-95)

The dynamics of Scientific manpower and output
by M.J. Moravcsik and S.C. Gibson
(Summary)

Particulary with developing countries in mind, a dynamical model is developed for predicting scientific production in the future, using some empirical and phenomenological knowledge about the attrition processes that affect scientific productivity. A general mathematical scheme is formulated and then a number of numerical examples are given. It is shown that the naive models (used very prevalently at the present time) are likely to overestimate future production by as a factor of ten compared to more realistic predictions. In fact we show that an exponential increase in scientific production does not occur under all circumstances, but only if the quality of the scientific manpower is high. If the opposite is true, production might even decrease exponentially with time, unless shored up by a constant importation of foreign scientists. A number of policy consequences are derived from the results, involving the degrees of importance of education abroad, of education locally, of the acquisition of foreign scientists, of quality in science-building, and the inevitability of acquiring some research-wise 'deadwood' scientific man-power that must then be utilized in other ways.

(Research Policy, 8, 1(January, 1979) Pp. 26-45)

History of Science Losing Its Science

By William J. Broad

Once a highly respected field that focused on the conceptual evolution of scientific ideas, the history of science is losing its grip on science, leaning heavily on social history, and dabbling with shoddy scholarship.

That, at least, is the situation as seen by Charles C. Gillispie, a historian of science at Princeton University who spoke at the AAAS annual meeting. Gillispie warned the attending scientists to keep a close watch lest the field fall prey to those who would use history against science.

Take a recent round table at the Princeton University school of political science, for example. "Do scientists have blood on their hands?" was the title of a discussion on the history of atomic weapons that Gillispie attended on a whim. The predictable conclusion, he said, was that they do. "There was no one present, either on the panel or in the audience, who knew how the technical prospects for atomic weapons appeared to the physicists concerned at any of the junctures at which they sought to make known the possibilities. The atomic bomb was treated as a foregone conclusion from the moment Hahn and Strassner split the uranium atom - though none of the panelists had the least idea what in fact had happened, and only a vague idea of when it happened."

Less odious but still troublesome to Gillispie are social histories that ignore science altogether, such as studies that deal with the role of women in a particular scientific institution but omit their actual scientific work. "The effect," he says, "is a little like a social history of Philadelphia in 1776 which never mentions political theory and where the signers of the Declaration of Independence are men about town."

Another trend, he said, is that scholars focus on the personal and anecdotal: Newton on alchemy rather than on motion. Kekule's snake dance rather than the benzene ring, Darwin's neurosis rather than his marshaling of evidence. Some so-called scholars focus on scandal. Did Mendel really falsify his data? Did Hale really hate his wife? "These scholars," says Gillispie, "have a lust for just the sort of thing most rigidly ruled out of court in the science we do now- the irrational, the personal."

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Gillispie's position, unusual for having been taken in public, is privately expressed by many old-school historians of science. When the field was first founded, many of these scholars were themselves scientists. After studying mathematics, a "hard" science such as astronomy or physics, and the modern languages in which science was transmitted, they learned Greek, Arabic, and Latin. They studied old texts. George Sarton, who helped found the field shortly before World War I, is said to have been perfecting his Mandarin in his late 60's.

During the past two decades, however, students of science history have tended to be political scientists who know little of science and its history and who focus on the social implications of science. "Feelings here are so strong," says Gillispie, "and the science so technical, that any thought of controlling judgement of the events by knowledge of the science is normally abandoned at the outset. The more sensational the title, the less the sensitivity to the reciprocity of the influences between physics and politics or war, and the grosser the depiction of scientists as hucksters of weapons and research."

Though Gillispie says there is doubtless much to be learned from this approach, the trend is sometimes taken to extremes. "Scientists should pay attention to what historians and other social scientists are making of their enterprise. They should exercise a measure of vigilance, at least over the references to technical matters that even the most externally minded commentators cannot altogether avoid."

(Science, 207, 4429 (January 25, 1980) p.389)

* * * \

The Ecology of our Science
By Lynn White Jr.
(Extracts)

...Every age - doubtless including our own - holds operationally sustaining beliefs which other ages reject contemptuously as superstitions...
...Medieval astrologers produced a considerable literature calculating tidal variations in terms of the relative positions of sun and moon. In modern times it became possible to estimate similar tides in the earth's crust. Very recently these tides have been studied to determine their effect on the motion of great continental and oceanic plates that cover the earth...

...The entire history of science shows that, in varying degrees, much that even the greatest dead scientists believed to be fact is today either false or else somewhat less than factual, perhaps even superstitious. It follows that what the best scientists today believe to be fact will suffer the same fate... ..
...Since all of us yearn - often unconsciously - for stability, perhaps scientists are particularly vulnerable to the sin of finding superstition in other people and only truth in themselves...

...The problem is not public ignorance but public alienation. Moreover, the chief reason for this alienation is the reluctance of most professional scientists to be as objective about themselves, their values, their goals, and their intellectual methods as they claim to be about interpreting specific data.

...In January, 1610, Galileo, using his own improved model of the newly invented Dutch telescope, saw the four chief satellites of Jupiter and rushed the news into print within two months. At almost the same time a careful German astronomer, Simon Mayr, likewise claimed he sighted Jupiter's largest moons through a telescope and baptized them, including Io, with their present names. Galileo had previously feuded with Mayr calling him a poisonous reptile and enemy of all mankind. Now, furious again, he charged Mayr with plagiarism and, indeed, with never having seen Jupiter's moons. Mayr's tables of the mean motions of those satellites, however, were more accurate than Galileo's and were, in fact, published earlier.

...Moreover, by finding varying spots on the face of the sun, Galileo proved that change in fact occurs in the heavens. Thus he unified celestial and terrestrial physics and showed that the idea of inherent perfection is irrelevant to the sciences...

In fact, the history of global science - although still inadequately researched - seems to indicate that great scientific traditions, after long periods of productivity, at last decay. They decay precisely because they do not, or cannot, concern themselves with what has come to interest most people in their civilization...

From the fifth century B.C. until well into the sixth century A.D., Greek science continued to be creative...

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...Christians were not hostile to science - the last great scientists of that epoch, like Philoponos and Anthemios, were Christians. But most Christians expected the imminent end of the world. Only the individual soul and God were permanent...

Islamic science emerged at the end of the eighth century in Iraq with a sudden explosion of Arabic translations of scientific works either from Greek or from Syriac versions of Greek originals. Some material from Sanskrit also found new readers in Arabic. With amazing speed scientists writing in Arabic began to achieve original results that in many fields went far beyond those of the Greeks...

...In Western Europe between about 1125 and about 1275 remarkable numbers of Arabic texts appeared in Latin...
...In the early 13th century in Cairo Ibn al-Nafis discovered the pulmonary circulation of the blood, No rumor of this reached Europe until the middle of the 16th century when it was mentioned by the Spanish physician Michael Servetus. Had it been known earlier, William Harvey's great discovery in the 17th century might well have been anticipated...

If the health of our Western science is to be maintained into the deeper future, we need new kinds of communication between scientists and the rest of us, and communication in a new mood...

...Modern science has been produced chiefly by two instruments: mathematics and the laboratory. Mathematics plays a part in ecological research, but conclusions rest on an almost aesthetic perception of the counterpoint among a vast array of qualitatively different quantities of both organic and inorganic beings...

...At a time when science and engineering have combined so amazingly both to sustain and to endanger Homo sapiens, those of us who are not scientists have a duty as citizens to develop an informed opinion on each issue of national or local science policy. Science is no longer just a matter for scientists. The basic dictum of democratic law applies: "What touches all must be ratified by all."

(Science 80, 1, 1(Nov./Dec., 1979) pp.72-76)

Venus and Science's Fringe

The planet Venus is the pivotal object in the grandest catastrophe theory of them all. Immanuel Velikovsky, who died at the age of 84 last 17 November, envisioned Venus as an awe-inspiring vagabond of the solar system. Ripped from the core of Jupiter more than [illegible] years ago, the comet-like Venus caused havoc in the inner- solar system as it careened by Earth before finally settling down in its present orbit. According to Velikovsky and his supporters, Venus still bears vestiges of its fiery origin and subsequent travels.

Spacecraft missions to the planets have provided new but not always convincing arguments for the supporters of Velikovsky in their sometimes heated exchanges with establishment science. The Pioneer Venus mission is no exception, but the defenders of the fringe may actually be in a smaller corner than before Pioneer.

The inability of scientists to find a complete, conventional explanation for the high temperature of Venus's atmosphere (see story), would seem to leave an opening for Velikovsky supporters. Because of its origin in the core of Jupiter (where scientists believe the temperature to be 20,000°C) Venus is a source of heat, according to Velikovsky. He wrote in 1967 that the ashen light, a brightening of the dark side of Venus sometimes seen from Earth, "seems more properly to be incandescence glowing through the (cloud) envelope." He also suggested that "its body was all molten or plastic not so long ago." Current reports of an apparent flow of heat up from the surface into the lower atmosphere might soon be used to support such a thesis, but observations from the Pioneer orbiter suggest that the planet as a whole is not acting like a radiator.

The orbiter instrument measuring the absorption and radiation of energy by the planet has not found that Venus is losing any more heat that it is absorbing from the sun. Although the precision of the measurements (±15 percent) is not yet as great as it will be, Frederic Taylor of the Jet Propulsion Laboratory in Pasadena believes that there is little room left, if any, for a source of heat on Venus.

Velikovsky assumed for various reasons that "Venus must be rich in petroleum gases.... Venus must have hydrocarbons and carbohydrates in its clouds. "Supporters claimed that early reports of possible high levels of methane in the Venusian atmosphere substantiated the Velikovsky prediction, but Pioneer team members now assume that the methane was mostly in the mass spectrometer, not in Venus's atmosphere. A duplicate instrument in a methane-free atmosphere in the laboratory also saw large amounts of methane, apparently because methane used as a calibration gas was recycled through the instrument. Between the gas chromatograph and the mass spectrometer, the only hydrocarbon detected in the atmosphere was ethane at a concentration of a few parts per million. Even when the mass spectrometer sucked in a cloud droplet, no petroleum hydrocarbons or carbohydrates appeared.

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The picture of Venus as a planet of mountains, broad craters, expansive plateaus, and towering volcanoes, which is being supported by the orbiter's radar mapper, is receiving less attention than heat and hydrocarbons. David Morrison of the University of Hawaii has suggested that all of these features indicate that Venus's crust was not recently molten or plastic but is rigid. Harold Masursky of the U.S. Geological Survey in Flagstaff has also suggested that at least some parts of the crust are very old because it would have taken millions of years to accumulate the large craters already tentatively identified.

Although numerous counterarguments will undoubtedly be made to these establishment interpretations of the Pioneer Venus data, few converts to the fringe position are likely. In the long run, the number of converts is probably the best measure of the power of the catastrophists' arguments. During less than a decade, the once-ridiculed idea of moving continents won over nearly the entire earth science community. After 18 years of spacecraft studies of Venus, the fringe still stands alone. - .....

(Science, 207, 4428 (Jan.18, 1980) p.293)

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Accreting Neutron Stars, Black Holes, and Degenerate Dwarf Stars

By David Pines

(Extracts)

...Observations of compact x-ray sources have served as a great stimulus to theoretical astrophysicists. Particular attention has been focused on a class of models which involve a compact object - a neutron star, black hole, or degenerate dwarf star - that is accreting matter from a nearby "normal" companion star going through a phase in its stellar evolution in which it is losing mass...

... In this article, following a brief review of our present understanding of accretion flows toward magnetic neutron stars, black holes, and degnerate dwarf stars in binary systems, I consider the current output of the compact x-ray source "cosmic laboratory" and indicate some of the promising future avenues of investigation, with particular focus on those fundamental questions in physics which may be illuminated by such studies...

... In the case of neutron star formation, and possibly also black holes, some of the energy given off in the stellar collapse will, in the form of visible light, be observable on the earth as a supernova...

If, on the other hand, the rotating magnetic neutron star is accreting matter from a nearby companion star, it may be visible as a pulsating x-ray star. Far from the star its magnetic field will not influence appreciably the flow of accreting matter, since it is screened out by currents induced in the infalling material. If the matter possesses sufficient angular momentum, it cannot fall directly toward the star, but rather will tend to form a disk, made up of particles gradually spiraling toward the star on Kepler-like orbits. Sufficiently close to the star, the stellar magnetic field is strong enough to force the accreting matter to corotate with the star at its angular velocity, Ω)...

Because no radiation can escape its intense gravitational field (hence the name black hole), a black hole in isolation is not observable. Its properties (mass M, angular momentum J, charge Q) can, in principle, be determined by their effect on matter which is accreting onto it or, in the case of its mass, through the influence of its gravitational field on other stars in its vicinity. X-rays offer an extremely valuable diagnostic tool for the identification of a possible black hole...

Chaotic rapid time variability has been viewed as a likely signature of a black hole...

...Accreing degenerate dwarfs form an important class of galactic x-ray sources...

It should be emphasized that in all three cases, accreting neutron stars, black holes, and degenerate dwarfs, one is faced with the challenging problem of constructing a self-consistent solution for the emission region, where there is significant coupling between the emerging radiation and the accreting plasma. Some of the physical

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processes which must be taken into account in order to realize this goal are described, for the case of neutron stars and degenerate dwarfs, in the following sections...

Extensive theoretical studies have shown that neutron stars with a mass of ~1.4M have radii of the order of 10 to 16 km; a solid outer crust ~ 1 to 5 km thick containing increasingly neutronrich nuclei in a periodic array, free electrons, and free neutrons; and a liquid interior that begins at densities somewhat less than ρ_0 and contains largely superfluid neutrons...

At least three distinct hadron superfluids are expected inside neutron stars:

1) In the inner part of the crust (corresponding to densities $4.3 \times 10^{11} \leq \rho \leq 2 \times 10^{14}$ g/cm^3), the free neutrons, which coexist there with the neutronrich nuclei, probably form a $^1S_0$ paired superfluid...

2) In the quantum liquid regime ($\rho \gtrsim 2 \times 10^{14}$ g/cm^3), where the crustal nuclei have dissolved into free neutrons and protons, the neutron superfluid is likely in a $^3P_2$ paired state (68) containing a vortex array.

3) The protons in the quantum liquid interior are expected to be superconducting, again in consequence of the strong attractive hadron-hadron interaction...

(Science, 207, 4431 (Feb. 8, 1980) pp. 597-605)

First measurement of gas phase sulphuric acid in the stratosphere

By Arnold & R. Fabian

Summary

Sulphuric acid is thought to be the most important nucleating agent in the stratosphere and thus has a key role in the formation of the stratospheric aerosol layer ('Junge layer') . As the latter at least temporarily influences the Earth's radiation budget and thereby the Earth's climate , sulphuric acid is a very important stratospheric trace gas. The formation of stratospheric sulphuric acid is considered to proceed via a not yet fully determined photoreaction chain, strating from SO_2 (ref.6). Sulphur dioxide, in turn, is thought to result from OCS and possibly also from CS_2 being transported from the troposphere into the stratosphere . Direct SO_2 injection is also possible. We report here the first measurement of gas phase sulphuric acid abundances in the stratosphere. Our method relies on a recent composition measurement of stratospheric negative ions which revealed the presence of species containing sulphuric acid molecules attached to Hso4 Core-Ions.

(Nature, 283, 5742 (Jan.3, 1980) pp. 55-57)

North Atlantic oceanography as possible cause of Antarctic glaciation and eutrophication

By Detmar Schnitker
(Abstract)

Tarling suggested that ice ages may occur when continental blocks occupy polar positions, isolating the pole from oceanic influences, and when nearby seas are available to provide moisture for the build-up and maintenance of polar ice caps. Such conditions gradually became established in the Southern Hemisphere where the present ice age began 13 Myr ago. The Cenozoic circum-Antarctic geographic and oceanographic evolution has been recently summarised by Kennett. I report here that circum-Antarctic palaeogeography and palaeoceanography alone were insufficient to lead to the Antarctic glaciation. A model is presented that suggests that the final triggering events took place in the North Atlantic.

(Nature, 284, 5757 (April 17, 1980) pp.615-16)

The True Scientist

M.L. Roonwal (Zoological Survey of India, Raota, Jodhpur) in Journal of Scientific & Industrial Research 38(12): 665-7, Dec 79

..."How do we recognize excellence among scientists? There are various means to...distinguish genuine scientists from the imposters. It should not surprise us to find that, with phenomenal growth in the number of scientists and scientific opportunities, there is not an inconsiderable number among them who wear science but as a fig leaf to cover their nakedness. There are scientists who, after a period of genuine scientific research, take on the burdens of administering scientific departments or projects which may be as huge as the 'Moon Programme.' They are not to be blamed for this diversion. The running of these highly technical programmes and institutions can be done only by experienced scientists..."

(Source: Currents Contents - Phy. Chem. & Earth Sciences 20, 15 (April 14, 1980) p.17)

Research, Innovation, and University-Industry Linkages

By Denis J. Prager and Gilbert S. Omenn
(Summary)

Carter Administration actions to enhance basic research and stimulate industrial innovation have focused attention on the importance of formal university-industry cooperative relationships in science and engineering. We have examined the status of, and potential for, university-industry research consortia and research partnerships and the current and prospective roles of the federal government in stimulating such relationships.

(Science, 207, 4429 (Jan. 25, 1980) pp.379-84)

East Pacific Rise: Hot Springs and Geophysical Experiments

By F.N. Spiess et al.
(Summary)

Hydrothermal vents jetting out water at 380 ± 30 C have been discovered on the axis of the East Pacific Rise. The hottest waters issue from mineralized chimneys and are blackened by sulfide precipitates. These hydrothermal springs are the sites of actively forming massive sulfide mineral deposits. Cooler springs are clear to milky and support exotic benthic communities of giant tube worms, clams, and crabs similar to those found at the Galapagos spreading center. Four prototype geophysical experiments were successfully conducted in and near the vent area: seismic refraction measurements with both source (thumper) and receivers on the sea floor, on-bottom gravity measurements, in situ magnetic gradiometer measurements from the submersible Alvin over a sea-floor magnetic reversal boundary, and an active electrical sounding experiment. These high-resoultion determinations of crustal properties along the spreading center were made to gain knowledge of the source of new oceanic crust and marine magnetic anomalies, the nature of the axial magma chamber, and the depth of hydrothermal circulation.

(Science, 207, 4438(March 28, 1980) pp.1421-33)

Ocean Energy: Forms and Prospects

By John D. Isaacs and Walter R. Schmitt
(Summary)

The nature and distribution of power sources of the sea other than petroleum are discussed, along with possible entrees for their use. Waves, tides, currents, and salinity and temperature gradients all have the potential to contribute useful power. Submarine geothermal sources, salt domes, ice, and other marine-associated concentrations may be more important. There are opportunities to employ these marine power resources directly rather than for contributions to power grids or power-intensive products. Ancillary employment of the seawater as a coolant and of the sediments below the seabed for the disposal of nuclear wastes may be even more important uses than employment of the power that the sea contains.

(Science, 207, 4428(Jan. 18, 1980) pp.265-73)

The Bits and Pieces of Plate Tectonics : Parts of North America that always seemed geologically peculiar now appear to have been plastered onto the continent over the past 400 million years

By Richard A. Kerr

(Extracts)

...Geologists could not easily fit the rocks of coastal Alaska or New England with the rocks that surrounded them...

...Now, researchers in the relatively new field of paleomagnetics, the study of the earth's ancient magnetic field as recorded in rocks, are helping to identify late additions to the continents and for the first time tracing their origins...

...In 1968, Tuzo Wilson of the Ontario Science Center, Toronto, boldly concluded that some of those rocks, the geologically peculiar ones, were once parts of other continents. He suggested that part of Florida had come from Africa, coastal New England and Newfoundland from Europe, and parts of Nevada, British Columbia, and Alaska from Asia...

...Hamilton hesitated to spell out in 1963 the obvious conclusion that Idaho contained the remnants of an island chain. Only a few people took plate tectonics seriously then, but by 1969 Hamilton felt free to describe in detail how California must have been put together as the edge of North America swept up pieces of ocean crust, ocean sediments, and island arcs (like the Aleutians)...

...This addition of island arcs to North America is now known as the Stikine block, after the town of Stikine, British Columbia...

...By measuring the direction of the earth's magnetic field frozen into the rocks of each block, paleomagneticians have shown that these displaced terrains were as far south as the vicinity of the equator when their rocks solidified from lava...

Much of this story of plate-edge tectonics remains tentative. The 1500-kilometer-long fault required for Avalon's slipping along North America has yet to be identified by geologists, who generally prefer matching up the rocks on either side of a suspected fault slippage to shuffling crustal blocks around according to paleomagnetic data. At the same time, the paleomagneticians have their hands full collecting and analyzing enough samples to build a detailed picture whose magnetic record has not been distorted beyond recognition by the repeated mountain building...

The geological data supporting a Pacific origin for Central America are not as detailed as in other cases, but Gose believes that their paleomagnetic data are consistent with what is known about the regional geology. That includes a great fault through northern Mexico and the southwestern United States proposed by Lee Silver of the California Institute of Technology. This fault would have allowed the bulk of North America to swing away to the northwest as the Atlantic opened; this movement would mesh with the observed counterclockwise rotation of Mexico...

(Science, 207, 4435 (March 7, 1980) pp. 1059-61)

Gyromagnetisation: rocks in a spin

By R.L. Wilson

(Extracts)

Interesting experiments by J. Edwards at Aberdeen University (Geophys. J. in the press) show that one can induce larger rotational remanent magnetisations by rotating the sample during only part of the demagnetisation process. He also shows that the slow rotation affects magnetic grains whose coercive forces are considerably greater than the greatest alternating (peak) field applied. This seems to mean that the act of rotation, or 'tumbling', may considerably enhance the effect of a given peak alternating field, in demagnetising a given coercivity range within a sample. Effectively it makes the tumbling method a more powerful demagnetisation method than the stationary one.

Meanwhile, in this issue of Nature (page 48) A. Stephenson, of the University of Newcastle-upon-Tyne, reports his direct observations of the torque developed in a specimen which is rotating about an axis at right angles to an alternating field axis. The torque is quite appreciable, and is clearly related to the acquisition of rotational remanent magnetisation. Stephenson uses these results in support of a theory which relates rotational remanent magnetisation right back to the Barnett gyromagnetic effect; where a rock, rotating in the absence of a magnetic field, acquires a magnetisation caused by the alignment of internal magnetic moments along the axis of rotation (Rev. Mod. Phys. 7,129;1935)...

Stephenson's and Edwards' experiments are dealing with an effect which will touch upon several kinds of research. First, rotational remanent magnetisation provides us with a fairly easy means of studying gyromagnetism itself. At least experimentally there is little difficulty in reproducing the effect, but the theoretical interpretation of the results may be fairly difficult. Second, gyroremanent magnetisation may help us to measure and study magnetic anisotropy from the point of view of the solid state physicist. Third, the measurement of magnetic anisotropy in rock samples may be carried out by this new method, and used to interpret the stress histories of rock samples during geological time; the long term stress undergone by rocks often causes recrystallisation, the crystals (including the magnetic crystals) becoming aligned in a manner which is related to the stress field present during recrystallisation. Fourth, the understanding of rotational remanent magnetisation may help palaeomagnetists to learn how to demagnetise there samples in a more effective way than hitherto. Stephenson's second paper shows that even a stationary specimen in zero steady field, if anisotropic, will acquire an induced remanence during 'demagnetisation'. The practical demagnetisation problem then becomes "How does one tumble a specimen optimally to avoid induced rotational remanence in isotropic samples,

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gyroremanence in anisotropic samples, and ordinary anhysteretic remanence due to imperfect cancellation of the geomagnetic field?". A problem of some complexity, although it could just have a simple answer.

(Nature, 284, 5751 (March 6, 1980) pp.12-13)

* * * *

The Scarred Face of Japan
By Atsushi Tsuchida and Takeshi Murota
(Extract)

Ancient Greece once supplied industrial product to other Mediterranean countries in exchange for food, and the Roman Empire seized almost the entire farm output from the fertile lands of Carthage. But as we now know such massive international movements of food destroy both the land that exports it and the country that imports it. Vast quantities of topsoil from the once forested lands of Greece have been washed away, and the present territory of old Carthage, once the granary of Rome, is now half desert. The story is repeated again and again throughout the Mediterranean region. With such historical precedents must we now watch Japan repeat the old mistakes in her dealings with the United States? For Japan now stands where Ancient Greece and Rome once stood...

(The Ecologist, 9, 7(Oct./Nov. 1979) pp. 221-26)

Cancer and Inflation
By Samuel Epstein
(Extract)

Much has been made of the relationship between modern eating habits (particularly high caloric intake, high consumption of animal fats, and low consumption of grain and fiber) and the twentieth century cancer epidemic. On the basis of indirect evidence, it has been reasonably suggested that a low fiber, high fat diet increases the risk of colon and possibly other cancers, including breast cancer. However, the epidemiological case against fat is not at all strong, as there are populations that have high fat intake and little bowel cancer, and no case-control studies have yet identified fat as a risk factor. The apparent carcinogenic effects of a high fat diet, however, may well reflect an increased intake of a wide range of carcinogenic contaminants (accidental food additives) in animal fats, such as chlorinated hydrocarbon pesticides, which are still ubiquitous...

(The Ecologist, 9, 7(Oct./Nov. 1979) pp. 236-46)

Conceivable Ecodisasters and the Reykjavik Imperative

By Nicholas Polunin

(Summary)

An ecodisaster is here characterized as 'any major and widespread misfortune to, or seriously detrimental change operating through, Man's or Nature's habitat - whether or not it is engendered by Man himself, and whether or not it affects him directly'.

From this wide perspective but leaving aside such 'old favourites' as world famine and nuclear holocaust, and not yet dealing with population swarming and biotic invasion, are selected the following half-dozen items as being particularly pertinent: (1) Build-up of atmospheric carbon dioxide; (2) Disappearance of more and more of the life-support system; (3) Water shortage and salt build-up with continuing irrigation; (4) Loss of genetic diversity; (5) Increasing complexity of human existence and health-hazards; and (6) The Beirut syndrome of human slaughter.

The Reykjavik Imperative on the Environment and Future of Mankind was an outcome of the Second International Conference on Environmental Future and is a strong general statement of the world situation and foreseeable future both environmentally and demographically. It consists of a short preamble, a general part in sections under six main headings, and seventeen resolutions. In the Imperative are indications of actions that need to be taken - or, alternatively, avoided - if devastating ecodisasters are to be evaded and the world is to survive in anything like its present form as the habitat for Man and Nature.

(Environmental Conservation, 6, 2(Summer 1979) Pp. 105-109)

West European Institutional Arrangements for Environmental Policy Implementation - Especially Air and Water Pollution Control

By William R. Mangun

(Summary)

A comparative study of institutional arrangements for the implementation of environmental policies serves several purposes. First, it provides a better understanding of the governmental systems of the respective countries which are examined. Second, it provides a basis for the potential formulation of more effective environmental protection policies; this can be accomplished through a detailed analysis of the implementation efforts of countries which experience similar environmental problems, but may use different implementation strategies to deal with such problems. Third, it prompts the analyst to consider the effect of varying political cultures on the policy implementation process (Enloe, 1975). Fourth, such study often identifies the need for greater harmonization of environmental laws between different

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countries (Lutz, 1975). In sum, such study can reveal the key relationships between governmental structures and environmental policies which account for successful policy implementation (Lundqvist, 1974).

In this study the basic environmental policy stances, institutional arrangements, and implementation approaches, of several West European countries, are examined. Institutional relationships between central, regional, and local, governments are examined to show how responsibilities are distributed among different 'actors' in the policy process. The study reveals an ever-increasing enforcement burden, due to the enactment of new pollution control legislation, accelerated institutional innovation, and reorganization practically throughout West European countries, in the 1960s and 1970s. There is no set pattern, however, which is common to all the countries. Some countries created new and independent agencies, while others simply reorganized existing agencies. Yet other countries, such as Italy, did not substantially alter their organizational structure in order to deal with environmental problems.

The study also shows that pollution control approaches varied significantly among the countries examined. Some countries, such as Sweden, adopted comprehensive pollution-control policies which cover all basic areas of environmental protection, i.e. air, water, and land. Other countries, such as the United Kingdom and West Germany, developed vigorous air-pollution control policies, while countries such as France and the United Kingdom developed vigorous water-pollution control policies. In most countries the development of pollution control policies was of an additive nature, with expansion and improvement of basic air and water-pollution control laws. In most instances, Italy represented an exception to the pattern and provided the weakest environmental policy stance.

This study suggests that there is a clear necessity for present day governments to maintain a continuous process of institutional innovation in order to confront at all adequately the myriad, increasingly complex environmental issues.

(Environmental Conservation, 6, 3(Autumn 1979) pp. 201-11)

Environmental Analysis

By L.G. Jacobs

In reading articles on environmental issues, I have repeatedly felt that three areas receive insufficient attention.

1) Extrapolation. "Everyone knows" that extrapolation is statistically unsound and that curves apply only to regions validated by data. In environmental issues extrapolation is routinely used, since no data exist in some important areas. The fallacy becomes obvious in looking at the case of trace elements in the human body. Copper and zinc, for example, are absolutely necessary to life. In larger doses they are dangerous poisons. No extrapolation could predict this reversal at low dosage. We need data, not bad guesses.

2) Analysis. Environmental risk assessment is a cost-benefit analysis, but not a very good one. Cost-benefit analysis was popularized by industrialists, for whom it was a good tool. It consists of stating a mathematical inequality, or sometimes a simultaneous series of inequalities, which may be compared to determine the course most favouring some objective. Industralists state their data in dollar amounts, quite easy to contrast. But this is not the case in environmental matters. Consider cancer; in what unit do we state its risk? The probability of developing it? The probability of dying from it? The dollar loss due to disability? The amount of suffering? And can this last be quantified at all? How do we state as a number the value of saving the whale from extinction? Or the snail darter? Are these equal? There is no "unit of risk" as distinguished from the nature of the risk itself.

3) Risk. The "no risk" concept has no real existence. We live at risk from conception to death. Adding a specific risk may or may not be justified by circumstance. We save no lives by eliminating carcinogens from our environment. The mortality of those having and not having cancer is exactly the same - 100 percent. The real issue, length and quality of life, is hard to evaluate. Consider insecticides; on one side is the risk of poisoning; on the other is the risk of malnutrition or starvation. Which is cost? Which benefit? In choosing a course that will minimize outcomes perceived as "bad" and maximize those perceived as "good" there will be risks on both sides. There is often no conclusive way to identify and select an optimum.

(Science, 207, 4438 (March 28, 1980) p.1414)

OZONE DEPLETION WOULD HAVE DIRE EFFECTS

Academy panels predict increased incidence of skin cancer, decreased agricultural output if chlorofluoromethane release continues

By Thomas H. Maugh II
(Extracts)

Depletion of the earth's ozone layer resulting from the release of chlorofluromethanes into the atmosphere may have substantial health and environmental effects, according to a new report from the National Academy of Sciences. Increased ultraviolet radiation transmitted through the stratosphere as a result of the depletion may produce large numbers of new cases of skin cancer, reduce the productivity of agricultural crops, destroy larval forms of some marine life, and produce a slight warming of the earth's atmosphere...

Stratospheric ozone is important because it screens out most of the so-called damaging ultraviolet (DUV) radiation - light with wavelengths between 290 and 320 nanometers - emitted by the sun. A 16 percent reduction in stratospheric ozone will produce a 44 percent increase in the amount of DUV radiation reaching the earth's surface, and a 30 percent reduction in ozone will double DUV radiation...

The most important health effect of DUV radiation is the induction of skin cancer...

...a 16 percent reduction in ozone might cause an appreciable reduction in yield for at least a few crops...

Another potential effect of continued release of CFM's is a change in climate resulting from both direct and indirect effects...

...The net effect of continued release of CFM's at the 1977 rate, the committee predicts, will be an average warming of the earth's surface by a few tenths of one degree Celsius, or about 10 percent of the warming that is predicted to result from increased combustion of fossil fuels...

The panel considered a large number of ways in which use of CFM's could be controlled, and concluded that no one strategy would be effective for all uses. Instead, a combination of approaches will be necessary and their use will rely more on political and economic decisions than on scientific rationale. Among the possibilities:...

...Recycling on disposal. The government might, for instance, require and subsidize collection centers for refrigeration equipment.

(SCIENCE, 207, 4429(Jan. 25, 1980) pp.394-95)

FOREST COMPOSITION AT VARYING DISTANCES FROM A COAL-BURNING POWER PLANT

By C.R. Rosenberg et al.

(Abstract)

Examination of the effects of sulphurous emissions from a coal-burning power plant on the vegetation of mixed oak forest with white pine Pinus strobus L. and hemlock Tsuga canadensis (L.) Carr revealed that species diversity and importance values of certain species were inversely related to distance from the source of emission. Diversity and importance of white pine Pinus strobus L. and sweet birch Betula lenta L. increased with distance whereas the importance of white oak Quercus alba L. and red maple Acer rubrum L. decreased. Differences with distance were greater downwind than upwind. The data fitted hyperbolic equations using the reciprocal of distance from the emission source. Species richness and diversity were more sensitive indicators of pollution damage than growth assessments of individual overstorey species or groups of species.

(Environmental pollution, 19, 4(August, 1979) pp. 307 - 17)

TOXIC EFFECTS OF AMMONIA ON VEGETATION IN ONTARIO

By P.J. Temple et al.

(Abstract)

Ammonia injury to vegetations has been observed frequently in Ontario in recent years due primarily to increased agricultural use of liquid ammonia fertilisers. Of twelve major incidents of ammonia injury to vegetation investigated recently, eleven involved the manufacture, storage or transportation of liquid ammonia fertiliser. One case involved spillage of ammonia from a large refrigeration system. Data on foliar injury symptoms and relative susceptibility to ammonia were compiled for over a hundred species of native and cultivated plants injured in these episodes. Symptoms of acute injury on woody plants usually consisted of large, irregular, dark brown or black necrotic lesions scattered over the surface of the leaf. Some thin-leaved herbaceous plants developed necrotic lesions that bleached to an ivory or light tan colour. The most susceptible species were balsam poplar, red mulberry and catnip. Maples and conifers appeared to be very resistant to foliar injury.

(Environmental pollution, 20, 4(December 1979) pp.297-302)

Small RNAs and splicing

By Richard Roberts

THE small RNAs found in the nuclei of eukaryotic cells (snRNAs) were first described by Weinberg and Penman more than 10 years ago. They range in size from 90 to 220 nucleotides, are only found in the nucleus and have unusual 5' -terminal structures. These structures resemble the 'cap' structures of eukaryotic mRNAs but contain 2,2,7-trimethylguanosine rather than 7-methylguanosine as the blocking residue. They also contain some additional modified bases notably pseudouridine and 2 -O-methyl nucleosides. Although several (U1, U2, UU3B) have been sequenced by Busch and his colleagues, their function is unknown. This may soon change however as a new experimental attack has been launched which could lead to fresh insights into both the function of these snRNAs and the processing of initial RNA transcripts.

Experiments described in two recent papers (Lerner & Steitz, Proc. natn. Acad. Sci. U.S.A. 76, 5495; 1979 and Lerner et al., this issue of Nature page 220) have uncovered an interesting class of subnuclear particles and provide the basis for some fascinating speculation about 'RNA splicing.' The experiments are based on old reports (Mattioli & Reichlin J. Immunol. 107, 1231; 1971; Northway & Tan, Clin. Immunol. Immunopathol. 1, 140; 1972) that certain patients suffering from systemic lupus erythematosus possess circulating antibodies directed against a ribonucleoprotein complex present in the nuclei of many eukaryotic cells. In the first paper, Lerner and Steitz have characterised the RNA and protein components of this complex. They show that the complex contains a specific set of seven polypeptides with molecular weights between 12,000 and 35,000, which are neither histones nor the polypeptides associated with the 30S hnRNP particles. The RNA components are the small nuclear RNAs described above. Different antisera precipitate different subsets of these small RNAs, but always with the same set of seven polypeptides. Furthermore, the experiments show that the snRNAs may be quantitatively precipitated from nuclear extracts in the form of these ribonucleoprotein complexes. The authors propose that each snRNA can interact with the same set of seven polypeptides to form a discrete ribonucleoprotein particle (snRNP).

A further step in the characterisation of the snRNPs is described in this issue of nature (Lerner et al.). First it is shown that the lupus antisera precipitate similar snRNP complexes from a variety of eukaryotic sources, ranging from man to insect, indicating that these complexes have been highly conserved during evolution. They are not found, however, in tobacco, yeast, Dictyostelium discoideum, or E. coli extracts. They are present in highest abundance in metabolically active cells, and from such cells they sediment, in sucrose gradients, with a molecular weight (30S) far greater than that observed (7-10S) for the free snRNA species. This suggests that the 7-10S particles are themselves bound to some other moiety of much higher molecular weight. The authors speculate that the high apparent molecular weight may be due to the attachment, of the snRNP particles, to hnRNA, which is itself associated with 30S hnRNP particles.

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The arguments leading to this prediction, while not compelling, are highly intriguing. Several groups have examined the sequences present around the splice junctions in hnRNA and defined a consensus sequence from which any one sequence diverges by only a few nucleotides. This is postulated to be a 'preferred' sequence at which splicing could occur. By examing the sequence of a major snRNA (U1A), the authors noted that its 5' -terminal sequence shows extensive complementarity to this preferred sequence. Nucleotides 3 to 8 from U1A exactly match that part of the 'preferred' sequence found at the 5' end of the intervening sequence, while nucleotides 9 to 11 exactly match the 3' end of the intervening sequence. Some further possibilities for base pairing exist between nucleotides 12 to 20 of U1A RNA and the continuation of the 3' intervening sequence. Thus it is hypothesised that the 5' -terminal sequences of U1A RNA interact with the terminal sequences of the intervening regions and thus serve a template function by correctly aligning the sequences to be spliced. Consistent with this role for the 5' -terminal sequences of U1A RNA is the finding that among the snRNP particles is a minority class which does not show the high apparent molecular weight in sucrose density gradients. This class contains a shortened form of U1A RNA which is missing both the 5' terminal 'cap' structure and the first six nucleotides from the 5' end. The absence of these nucleotides would seriously disrupt the fit required by the model. It is not known whether these particles, containing the shortened form of U1A RNA, are an artefact of isolation or have metabolic significance.

A similar scheme has previously been proposed in the adenovirus-2 (Ad2) system, this time invoking the Ad2 encoded VA RNA as a template for the processing of late Ad2 mRNAs (L. Philipson, unpublished News & Views 277,593; 1979; Murray & Holliday FEBS Lett. 106, 5; 1979). Here, the detailed model of Murray and Holliday seems less attractive since it requires base pairing with nucleotides which lie beyond the known 3 end of VA RNA. Whatever the final outcome of these predictions, it seems that at last an experimental system is available for the study of RNA processing events within the eukaryotic nucleus and such studies should be spurred by the tantalising hypothesis developed in this latest report.

Amidst the frenzy of activity presently aimed at cloning and sequencing DNA, we should perhaps remember that many of the highly conserved processes of molecular biology involve only RNA and protein. The specificity of protein synthesis is provided by the triplet interaction between tRNA and mRNA, while its initiation requires RNA-RNA interaction between the 3' -end of ribosomal RNA and mRNA. The ribosome which catalyses this process contains both RNA and protein and recently an RNA processing enzyme, RNase P of E. coli, has also been

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shown to consist of both RNA and protein (Stark et al. Proc. natn. Acad. Sci. U.S.A. 75, 3717; (1978). Some of us would argue that this reflects the early establishment of these processes during evolution, at a time preceding the arrival of DNA on the biological scene. If RNA splicing is also a process which developed at an early stage in evolution (News & Views 272, 581; 1978; Darnell, Science 202, 1257; 1978) then it may not prove surprising if its specificity also depends upon RNA-RNA interactions.

(Nature, 283, 5743 (January 10, 1980) pp.132-33)

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New Recombinant DNA Guidelines
By Bernard Talbot

The statement that "All gene splicing experiments with E. coli K12 may now be conducted in minimal (P1) containment" (News and Comment, 15 Feb., p.745) is not correct. The revised National Institute of Health (NIH) Guidelines for Recombinant DNA Research, as promulgated on 29 January 1980, continue to prohibit certain experiments using E. coli K-12 and continue to exempt others from the guidelines. Still other experiments are permitted at P1 containment, but only when an EK1 host-vector system is used, "(i.e., (a) the host shall not contain conjunction-proficient plasmids or generalized transducing phages, and (b) lambda or lambdoid bacteriophages or non-conjugative plasmids shall be used as vectors)." The September 1979 proposal of the NIH Recombinant DNA Advisory Committee was not accepted in toto. The NIH Director rejected an exempt status for such experiments and required a more conservative review procedure for "any experiment in which there is a deliberate attempt to have the E. coli K-12 efficiently express any gene coding for a eukaryotic protein."

(Science, 207, 4437(March 21, 1980) p.1296)

No evidence found of link between saccharin and cancer
(Extract)

No evidence of a positive link between the consumption of saccharin and an increased incidence of bladder cancer has been revealed by either of two studies whose results were published last week. One was carried out by Harvard University's School of Public Health and the other by the American Health Foundation.

The scientists who carried out the study, which involved surveys of the dietary habits of 592 and 367 bladder cancer patients respectively, point out that these results have two possible implications. Either saccharin does not cause cancer, or that its effects are too small to be identified by such studies....

(Nature, 284, 5752(March 13, 1980) p.116)

Gasohol: A Choice That May Buy Grief
(Extract)

Proponents of gasohol, who have built a powerful lobby among farm state senators, contend that alcohol production from corn will not reduce the amount of food available because the protein content of the corn is untouched and can be fed to livestock. Brown observes that starch is also a valuable component of food. In any event, he believes, the worldwide use of crops for energy is "certain to drive food prices upward, thus leading to more severe malnutrition among the poor."

(Science, 207, 4438 (March 28, 1980) pp.1450-451)

The Climatological Significance of a Doubling of Earth's Atmospheric Carbon Dioxide Concentration

By S.B. Idso
(Abstract)

The mean global increase in thermal radiation received at the surface of the earth as a consequence of a doubling of the atmospheric carbon dioxide content is calculated to be 2.28 watts per square meter. Multiplying this forcing function by the atmosphere's surface air temperature response function, which has recently been determined by three independent experimental analyses to have a mean global value of 0.113 K per watt per square meter, yields a value of ≤ 0.26 K for the resultant change in the mean global surface air temperature. This result is about one order of magnitude less than those obtained from most theoretical numerical models, but it is virtually identical to the result of a fourth experimental approach to the problem described by Newell and Dopplick. There thus appears to be a major discrepancy between current theory and experiment relative to the effects of carbon dioxide on climate. Until this discrepancy is resolved, we should not be too quick to limit our options in the selection of future energy alternatives.

(Science, 207, 4438(March 28, 1980) pp.1462-463)

Order and intracellular location of the events involved in the maturation of a spliced tRNA

By D.A. Melton et al.
(Abstract)

Microinjected frog oocytes were used to analyse the RNA processing steps which lead to the appearance of a mature cytoplasmic tRNA molecule. The results show that removal of the intervening sequence from within a yeast tRNA precursor, excision of extra 3' and 5' nucleotides, addition of a 3'-terminal CCA and modification of at least seven ribonucleotides all occur in the nucleus before the tRNA is transported to the cytoplasm. Moreover, we find that the ribonucleotide modifications occur in a strict order which precisely correlates with the size alterations of the tRNA precursor.

(Nature, 284, 5752(March 13, 1980) pp.143-48)

Bacteria turn into magnets by growing crystals

Can an individual cell be sensitive to the Earth's magnetic field, and if so how? Richard Blakemore, Richard Frankel and Ralph Wolfe, of the Department of Microbiology at th University of New Hampshire, now report in Science (vol. 203, p. 1 "5) their first steps towards answers. They have isolated a bacterium from the wild, which will grow crystals of magnetite when cultured in an ironrich medium. These crystals turn the cells into magnets.

The team found its bacterium in the mud below the water of Cedar Swamp, Woods Hole, Massachusetts. The bacterium - called spirillum and looking like a tiny helical balloon - consistently rotated to line up north-south. Characteristics other than its magnetic properties suggested it was previously undescribed magnetotatic spirillium, which led to its liberated name of MS-1.

The three researchers cultured the bacteria in liquid medium, with and without iron, and then tried to discover what kind of iron was present inside the cells. In an iron-rich medium the cells formed chains of square crystals, each crystal roughly 50 nanometers thick. (There are 1000 nm in 1 mm.) The magnetic bacteria grow an average of 22 crystals each arranged around the central inner core. When cells were cultured in media that contained progressively less iron, no crystals were formed, and the cells contained less than one-tenth the amount of iron in magnetic cells. These iron-deprived bacteria were not magnetic.

The team then compared the bacterial iron with various types of inorganic iron to see what exactly the cells had made. On the whole, iron seemed to be magnetic, though there were small differences that could mean that some of the crystals were ferritin or some other iron compound.

So why is the bacterium magnetic? MS-1 is an "obligate microaerophile", which means that it needs just the right amount of oxygen; not too much, nor too little. The vertical component of geomagnetic force is stronger than the horizontal; magnetite may enable these spirillum bacteria to move vertically and locate exactly the correct depth in the mud, where the amount of oxygen is right for them Magnetite is also found in the abdomen of live bees and in pigeon skulls; perhaps it is used in these animals' remarkable feats of navigation, though exactly how remains unclear.

(New Scientist, 82, 1151(April 19, 1979) p. 187)

TWO DECADES OF EXPERIMENTAL AND CLINICAL ORTHOTOPIC HOMOTRANSPLANTATION OF THE HEART

By Norman E. Shumway and Edward B. Stinson
(Summary)

Orthotopic homotransplantation of the heart was introduced in the laboratory 20 years ago. The mean survival in untreated animals was 7 days, very similar to the survival period for renal transplants. Through the introduction and use of chemical immune suppression, long-term survival of the experimental animal after orthopic cardiac transplantation was effected by the mid-1960s. Adding antilymphocyte globulin or antithymocyte globulin in the late 1960s permitted clinical introduction of cardiac replacement by means of the homograft, and today, some 10 years later, the 1-year survival has moved from 22 percent in the initial program year to approximately 70 percent in the tenth year of clinical application. Meanwhile, efforts continue in the laboratory to identify better protocols of immune suppression, perhaps even specific tolerance which has thus far eluded discovery.

Who knows but that our heart replacement patient of the future may have a choice between the cardiac homograft after induced specific tolerance or the mechanical heart with an inexhaustible, implantable power source, a finding incidental perhaps to studies in perpetual motion by a little known sect of alchemists.

(Perspectives in Biology and Medicine, 22, 2(2) (Winter 1979) pp.S81-88)

GENES AND THE INNER CONFLICTS OF BEING MAN

By Susumu Ohno
(Extract)

...It is also likely that modern man tend to overestimate their own intelligence. Because of the wellorganized school system and the ready availability of publications, we assimilate knowledge accumulated by our predecessors of the last few thousand years as well as that of our contemporaries. Thus, what passes as an individual's intelligence is in reality the collective intelligence of the entire species. The innate intelligence of human individuals might in fact be quite meager, just a little higher than that of the chimpanzees. If we define creativity or inventiveness as the true measure of innate human intelligence, even those civilizations which we now regard as exceptional appear to have suffered peculiar lapses in this quality...

(Perspectives in Biology and Medicine, 22, 1(Autumn 1978) Pp. 3-9)

Single cell protein organism improved
By Robert Walgate

MICRO-ORGANISMS selected by the British firm Imperial Chemical Industries (ICI) to produce single cell protein (SCP) have been made more carbon-efficient by an application of recombinant DNA techniques, the firm announced last week.

ICI recently established the world's largest SCP fermenter - more than 50m high - using a methanol-consuming organism known as ASI. But the process has been under constant market pressure from agriculturally-produced soya-bean protein (both are used as animal feed supplements) and so ICI has been at pains to reduce the basic cost of its SCP. One obvious target was to improve the efficiency with which ASI converts the costly methanol feedstock into protein.

Protein requires nitrogen, and ASI gets its nitrogen from ammonia. But ICI discovered that ASI assimilates the ammonia by an energy-inefficient pathway - one using the enzyme glutamate synthase to convert ammonia to glutamate. The energy for this comes ultimately from the oxidation of methanol to carbon dioxide, so the result is an excessive consumption of methanol.

But some organisms have a different pathway, using glutamate dehydrogenase, which is less able to scavenge small amounts of ammonia but is more energy-efficient (and thus carbon-efficient). The possibility thus arose that the glutamate synthase gene in ASI could be deleted, and the glutamate dehydrogenase gene substituted for it.

Luckily the well-studied Escherichia coli has the right gene, and Dr John Windass of ICI Corporate Laboratory was able to excise its gene and insert it into ASI. The greatest problem turned out to be how to isolate an ASI mutant which had a deletion in the glutamate synthase gene: such mutants die immediately. However, ICI discovered a temperature dependent mutation - one where the glutamate synthase fails to operate above 37°C - and Windass inserted the dehydrogenase gene into this mutant.

Above 37°C this modified strain uses the dehydrogenase pathway for assimilating ammonia; and over a two-months period the strain has proved to be stable.

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Dr Windass, speaking at a recent biotechnology meeting in Roterdam, claimed that the engineered strain produced a "significant" improvement in carbon efficiency. Questioned whether a 3 to 5% improvement would justify the long toxicological studies that would be required if the strain was eventually to be employed, another ICI representative, Dr Peter Senior remarked that it would.

Toxicology studies are underway on the new strain, but it would be "at least five years" before it could be used. The strain could be adopted in the newly commissioned SCP plant, but there its efficiency would be sub-optimal, said Senior. "You have to design your plant around your bug".

In fact, Senior believes that the future of biotechnology will not be all plain sailing. "All the easy things have been done", he went on. "Biotechnology is grossly overselling its potential, and there is little likelihood on both scientific and economic grounds that we are staring a revolution in the face".

Conceptually the simplest biotechnical process was the growing and harvesting of single cell organisms, said Senior, yet "from my experience the single cell protein processes that have been developed at ICI have stretched the imagination and innovative skills of all those involved in their development to a degree that the conventional chemical industry has not experienced before".

The ICI single cell protein process was first envisaged in 1968; in 1976 a sum of £40 million was sanctioned for the construction of a large plant, which is now on the point of production.

(Nature, 284, 5756 (April 10, 1980) p.503)

The origins of biotechnology

By Peter Newmark

THE most ancient biotechnological art is fermentation - in the raising of dough, the brewing of alcohol, and the production of tea, coffee, and cocoa (each of which requires fermentation step). But the new wave of biotechnology rests on two main techniques: genetic manipulation and enzyme (or cell and cell organelle) immobilisation.

Genetic manipulation is used by the biotechnologist to enhance the natural genetic repertoire of a microorganism. The aim is usually to donate to the microorganism a gene for an enzyme or a hormone in such a way that the product of that gene is thenceforth synthesised by the microorganism. The successful development of genetic manipulation has rested upon the discovery of new enzymes and the improvement of old techniques by molecular biologists and microbiologists.

Crucial to the success has been the development of vectors for carrying foreign genes into microorganisms. Also of great importance has been the acceleration of DNA sequencing technology.

The real cornerstone of genetic manipulation, however, has been the discovery of enzymes that cut DNA at specific sites (restriction enzymes), seal the cuts up (ligase) and copy DNA from messenger RNA (reverse transcriptase). The first two of these are needed for the insertion of foreign genes into the DNA of the vector. Reverse transcriptase has become particularly important in the last two years since the revelation that the genes of higher organisms are 'split' (the coding DNA being interrupted by non-coding segments). In sharp contrast, bacteria do not have split genes and cannot decode split genes that are transferred to them. Therefore it is necessary to transfer an unsplit equivalent of the gene, which is precisely what reverse transcriptase produces from messenger RNA. Alternatively, due to recent advances in the technique of DNA synthesis, it is also possible to make purely synthetic genes at least for small peptide hormones.

The use of enzymes is an older technique, applied in a number of industries from baking to detergents. But purified enzymes are soluble molecules and it is therefore not easy to separate them from the product of their labour. Further more it is difficult to recycle the enzyme. These difficulties have led to the development, in the late 1960s, of immobilised enzymes. The enzyme is bound chemically to a solid matrix or entrapped in a smallpore gel.

Immobilised enzymes have been successfully applied, for example, to the production of semi-synthetic penicillins, to the large-scale production of fructose from maize, and to a simple assay for blood cholesterol.

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Immobilised cells or organelles have potential advantages when the stabilisation of an enzyme is difficult, or when a coenzyme or sequence of enzymes is required for synthesis.

Biotechnology may be dominated by microbial and enzyme technology, but it is certainly not synonymous with them. Both animal and plant cells have their place in the armoury of the catholic biotechnologist. Successful exploitation of animal cells has been achieved, for example, by Wellcome Research Laboratories in the production of interferon from virusstimulated lymphoblastiod cells.

A completely distinct exploitation of animal cells lies behind the commercial production of high grade antibodies for research, diagnostic and clinical use (for example for tissue typing prior to transplantation). The key to that is the hybridoma cell, an 'invention' of five years ago. Natural antibody-secreting cells neither survive long enough in culture nor produce pure enough antibodies to be a commercial source of antibody. But a hybridoma cell, the result of fusing an antibody-producing cell with a tumour cell, grows and divides continually. And all the cells from the original hybridoma secrete the same, pure antibody.

Work is also going ahead in many countries on the problem of nitrogen fixation - attempting to extend the range of associations of the nodule-forming, nitrogen-fixing, bacterium Rhizobium to plants other than the Leguminosae (particularly cereals), or to transfer the nitrogen fixing genes to plants - a distant prospect, given the extreme oxygen sensitivity of the pathway. There is also the distant prospect, through genetic manipulation, of a new source of controlled genetic variability in plants to produce new high yielding or resistant varieties.

(Nature, 283, 5743 (January 10 1980) pp. 124-25)

Neuroscience in Pesticide Research

M. Barend Ter Haar in Trends in Neurosciences 2(12): 1R-2R, Dec 79

..."The most obvious and most vulnerable site for attack in the insect is the nervous system, since this system is vital to all aspects of the insect's life.... Therefore it has been, and will continue to be, important to understand the workings of various insect nervous systems, and to find ways in which these systems differ from those of mammals, if we want to develop a 'safe' selective insecticide. This should also help avoid the objections relating to environmental pollution."

(Source: Current Contents - Phy. Chem. Sc., 20, 20(May 19, 1980) p. 12)

Eleventh hour for biotechnology in Britain

(Extracts)

WHETHER or not the National Enterprise Board decides to, or is allowed to, set up a biotechnology company, he Spinks eport published last week was right to have suggested th the Board consider the possibility (see page 502). There is little doubt that Britain has long been in need of companies prepared to risk investment in biotechnology. The only question now is whether it is too late.

As far back as 1975 it was obvious to a certain number of UK scientists that there was considerable commercial potential in new techniques emerging from molecular and cellular biology. In particular it was recognized that the technique of recombinant DNA might be used to harness bacterial and other cells to the production of pharmaceutically active polypeptides. Gene manipulation was also seen to have much to offer in the improvement of strains of microorganisms employed in fermentation and waste disposal. Bacterially cloned genes could also be foreseen as valuable in the diagnosis and therapy of congenital diseases. Equally there was early, if limited, recognition of the commercial potential of hybridoma cells which produce single antibodies - which are of considerable value in radiommunoassays and other medical diagnostic techniques...

...It is probably too late to think in terms of producing hormones and vaccines by means of genetically-manipulated bacteria; those are first generation applications already far advanced. But there is no shortage of second generation applications, particularly those involving fungal, mammalian and plant cells, with which a newly formed company might hope to leapfrog the early starters...

...The obvious way, as recommended in the Spinks report, is through the National Enterprise Board (NEB)... and/or the National Research Development Corporation (NRDC).

Although the NRDC already has some expertise and experience in the patenting and licencing of biotechnological processes, there are drawbacks to its further involvement. In the first place whereas it commonly gives a half share of royalties to any university from which a patented discovery has emerged, it is constitutionally unable to pass royalties back to research council laboratories. Secondly it is willing only to fund research with a clear commercial potential. Thirdly, and despite its having taken out such important patents as those on cephalosporins and interferon (unfortunately timeexpired except in the US, where it runs until 1989), the NRDC has not consistently spotted the winners. One glaring mistake is its 1975 decision that hybridomas had no obvious commercial applications.

(Nature, 284, 5756 (April 10, 1980) p.499)

Nuclear power: the critics must be heard

WHEN announcing the UK government's decision to build at least one nuclear reactor per year during the decade beginning 1982 Mr David Howell, Energy Secretary, placed great emphasis on the need for safety.

After the accident at the Three Mile Island nuclear power plant in Pennsylvania, US last March, public fears about the safety of nuclear power are justifiably strong. And in the UK, that fear is likely to be heightened by the government's probable intention to base the new programme on the pressurised water reactor - of a similar type to that at Three Mile Island - rather than the UK developed advanced gas cooled reactor.

Mr Howell was therefore right to stress the need for safety and to reaffirm the government's intention of holding a public inquiry on the safety of the PWR before the first is built. This view is endorsed by the new House of Commons Select Committee on Energy which recently announced that the PWR is to be its first topic for study. It is to call on Mr Howell and representatives from the nuclear industry and the nuclear opponents as witnesses and is to pay special attention to safety.

However, what will be most important over the next two years leading up to the public inquiry and indeed, throughout the subsequent construction of any power stations, is that Mr Howell's promise is seen publicly to be adherred to. The need for the nuclear industry to be entirely open about its plans is greater now than it has ever been. This is not the time for it to hide behind the government's decision in the hope that it will be out of the limelight. More than ever before, public attention will be turned on it and the public will expect its opinions to be taken into account.

The major lesson which must be learned from previous nuclear debates in many countries is the need for the critics of nuclear power to have complete access to information. We endorse the government's decision to release unabridged safety reports on all nuclear power stations but would go one step further. We recommend that the Nuclear Installations Inspectorate consider the opinions of the serious nuclear critics during any future safety assessments of nuclear power stations. This means that the critics must have the same rights of access to design and safety documents and the same rights to make site inspections as do NII inspectors.

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Greater openness will not be to the detriment of the nuclear industry. On the contrary, an industry which is seen publicly to be taking the right decisions about safety is one which will receive support at home and orders from abroad. Where safety is concerned, the industry should not worry about the need for commercial secrecy because the industry which is the most successful in demonstrating the safety of its reactors will be the one most successful in selling them.

Finally, the current decision should not automatically lead to the first step along the road to a major commercial fast breeder reactor programme. Rather it should be seen as a way of keeping our options open well into the 1990s. In the meantime, research - and particularly the development - of alternative sources of energy and new uses for coal should be stepped up. Only after equivalent funding will it be possible to make a balanced judgement between - say - fast breeders and wave power.

(Nature, 283, 5742(Jan.3, 1980) p.1)

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Solid progress with nuclear waste

A glass "sponge" that soaks up highly radioactive liquids could be an answer to the problem of nuclear waste disposal. Joseph Simmons and a team of researchers at the Catholic University of America have come up with this variant on the process of incorporating the highly active liquid wastes produced in a spent fuel reprocessing plant into a glass (Nature, 19 April, p 729).

The problem with past techniques of making the very active glass has been the high temperature needed to glassify the wastes. The best glass for containing "hot" wastes would be high-silica glass but these have to be made at elevated temperatures. Unfortunately, very hot, highly radioactive wastes are not very pleasant to handle, so a technique that allows the radioactive material to be processed at a lower temperature would be great advantage. The normal compromise is to make a less than perfect glass at a lower temperature. Simmons's team makes its glass at a high temperature, but at this stage no radioactive material is involved.

The researchers make a porous glass by producing a glass that can be turned into two separate phases - high-silica and low-silica phases - by heat treatment. One phase is dissolved by leaching in an acid solution that does not attack the other phase. The result is a porous glass. If the glass is soaked in liquid radioactive waste for several hours it will absorb the material, with perhaps a 20 per cent "loading" of waste in the glass.

The next stage would be to wash most of the liquid wastes out of an outer layer of the glass block. Then comes evaporation of the solvents. The glass is then heated slowly to between 625 and 700°C to complete the drying and to convert the waste material salts inside into an oxide form. The glass block is then further heated, to 900°C and the pores in the surface layer collapse. The final product is a solid block with radioactive wastes held in pores in its middle, while at the surface there is an envelope of high-silica glass.

Experiments with natural high-silica glasses show them to be very stable. The American team has made glasses incorporating materials which, while not themselves radioactive, are reasonably representative of the composition of nuclear wastes. The researchers claim that the new glass could be 10000 to a million times better than other waste encapsulation processes.

It will be some time before this new technique is completely tested to see if it can be used in radioactive waste management.

(New Scientist, 82, 1151(April 19, 1979) p. 171)

Melt-down experiment go-ahead

By Robert Walgate

FRANCE has removed its objections to an experiment simulating the melt-down of a nuclear reator, and so removed the last obstacle to the European Community's £530 million, 1979-83 programme for fusion research and support of the Joint Research Centre at Ispra, North Italy.

Italy, as part of its diplomatic activity over European research (3 January, page 3) had refused to endorse the budget of the EEC's fusion programme until France accepted the meltdown experiment, which is now to take place between 1983 and 1986 in the reactor Essor at Ispra.

France was planning its own similar experiment at Cadarache, but, says Mr Tom Doyle, head of Essor division, "Cadarache has only half the dimensions of ours" and the scale of the experiment substantially affects the results.

The US exerted pressure for the Essor experiment - called 'Super-SARA' - to be undertaken as a next step from similar, smaller tests which have been performed on the Power Burst Facility at Idaho. According to a 1979 Nuclear Regulatory Commission report Super-SARA should provide more information on melt-down than any other planned experiment.

"Essor is a heavy water reactor" Mr Doyle told Nature; "the active core is 1.5 metres high, compared to a typical research reactor's 0.8 metres." Moreover there are enough channels to make simultaneous tests on 36 fuel rods (compared to 16 at Idaho).

Super-SARA will consist of 20 experiments to simulate loss of coolant in a light water reactor either rapidly, over 10-20 minutes, or more slowly (the 'small break' case as at Three Mile Island). Fuel rods will be taken to the rupture of cladding, but it is intended to leave the rest of the reactor unaffected. This is "a bit of a difficult problem" says Doyle, but not insurmountable.

The experiments are necessary, he says, because calculations are very difficult; "you have a two-phase problem under transient conditions".

The successful flurry of diplomatic activity between Italy and France over Super-SARA began last December, when the EEC Council of Energy Ministers was faced with a French veto. The French High Commissioner for Atomic Energy in the case was Jean Teillac who, as President of the Council of the European sub-nuclear physics organisation, CERN, was resisting Italian moves to 'clarify' CERN's future.

(Nature, 284, 5754(March 27, 1980) p.295)

The accident at Three Mile Island
(Extracts)

On the need for action; however, the commission holds out a clear warning: "We are convinced that unless portions of the industry and its regulatory agency undergo fundamental changes, they will over time totally destroy public confidence and, hence, they will be responsible for the elimination of nuclear power as a viable source of energy."

We all recognise that the situation can't change overnight. We simply have to face the fact that we are presently going through a period of risk."

(New Scientist, 84, 1180 (November, 8, 1979), pp. 424-28)

The end of the large blue butterfly
By Derek Ratcliffe
(Extract)

The increasing destruction of natural and semi-natural habitats is such that over the next few decades we could see the extinction of species on an unprecedented scale. The impact of human exploitation of the environment has a simple message: the more than one organism exploits the productive capacity of the habitat, the less room there is left for other organisms. The problems are the same the world over - the only real differences are scale and timing. Some small islands have already suffered great losses under the human onslaught. Many endemic species have probably been lost before they could be described. Mauritius now has only 11 out of some 40 original indigenous bird species, and three of these are on the verge of extinction. The marvellous and unique wildlife of Madagascar faces similar difficulties; and the destruction of the tropical rainforests in Amazonia and the southwest Pacific islands is proceeding so fast that one wonders if the tale of the large blue could become the tale of the Morphos and birdwings which so excited the early traveller naturalists in these regions.

Nothing is safe now, anywhere in the world. How much survives will depend on how many people care, how much they care, and what they are prepared to do.

(New Scientist, 84, 1180 (November 8, 1979). pp.457-58)

Dutch to fall back on coal

IN an energy memorandum designed to foresee the country's needs until the beginning of the next century, the Dutch government has recommended a drastic reversal of its post-war policy to run down coal production. From a pre-eminent position in 1955, when coal contributed 96% of power plant fuel, the mining industry declined as natural gas fields came on stream in the sixties and early seventies. By 1975, coal contributed only 0.7% of the country's power plant fuel stock, and even after the 1973 oil crisis (which led to the reopening of mines in the south of Holland), it still contributes no more than 6%.

Now the government intends to boost coal production to a level where it supplies 40% of power plant fuel (12 to 14 million tonnes of coal a year) by the year 2000. Gas and oil, which currently account for 90% of power plant fuel, will be restricted to a 20% contribution, and a decision on where the remaining 40% can be found will be delayed at least until 1983.

At present there is an over-capacity in Dutch electricity generation, but this will disappear gradually as older plants are taken out of operation. Of the country's total of 15,000 MW installed capacity 520 MW is nuclear, and although the government made a decision in principle six year ago to install three more nuclear plants, discussions on specific proposals are expected to occupy at least two or three years yet.

An increased role for coal in industry is also forseen in the memorandum, which talks of fluidised bed combustion accounting for the use of five million tonnes of coal in the year 2000. This is expected to require an investment of at least 1½ billion guilders (£1=4.4 guilders).

Eventually, new technologies of in situ gasification and hydraulic mining will be needed to exploit the 100 billion tonnes of coal lying beneath the entire country at currently non-viable depths of 4,000 to 6,000 metres. In the meantime, an investment of three billion guilders will be required for the gasification of 7½ million tonnes of coal annually for industrial fuel and chemical production.

This coal gas will also be used in a mix with high-calorific North Sea or Algerian gas, or even burnt in power stations - an area in which Shell and the utilities have already taken an intitiative.

In a separate report, a group of Dutch industries has concluded that the role of coal should be even bigger than the government intends, and they call for an expenditure of 25 billion guilders (in contrast with the official estimate of 10 billion) to get the coal industry into gear by the turn of the century. They want reserves to be re-exploited at a quicker pace, and they urge demonstration projects in gasification and fluidised bed combustion within the next two years. To see this combustion revolution on its way, the indus-

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trialists suggest, Holland should have a national energy fund and a special under minister for energy (which at present remains in the portfolio of the Minister for Economic Affairs).

A corollary of both the government's and the industrialists' dreams for Dutch coal is that research and development will be required to ensure that the environment remains as clean as it is currently on a gas-dominated energy regime. Anticipating an increase in coal use from 1½ million tonnes now to 26 million tonnes a year by the end of the century, the government is setting up a national R & D programme to concentrate on atmospheric problems, pressurised fluidised-bed combustion and coal gasification, while applications will be explored for fuel gas desulphurisation work already carried out elsewhere.

Altogether, the research effort will cost 750 million guilders over the next five years.

(Nature, 284, 5753(March 20, 1980) p. 202)

Oxygen Ion-Conducting Ceramics: A New Application in High-Temperature-High-Pressure pH Sensors

By Leonard W. Niedrach

(Abstract)

Membrane electrodes fabricated from yttria-stabilized zirconia, a representative oxygen ion-conducting ceramic, show a linear voltage response to pH over the range 3 to 8 at 285°C and a pressure of 1200 pounds per square inch (82 atmospheres). Test units have been operated continuously at 285°C without failure for periods as long as 9 days. Unlike sensors which are based on electron transfer couples, such membrane electrodes are insensitive to changes in the oxidation-reduction environment and, in turn, exert no influence upon the environment. Such ceramic membranes can therefore be used for the direct measurement of the pH of geothermal brines, of water in nuclear reactors, and in high-temperature thermodynamic studies on aqueous systems.

(Science, 207, 4436 (March 14, 1980) pp. 1200-202)

Recent advances in polarized electron sources

By Daniel T. Pierce & Robert J. Celotta

IN his article "Polarized electrons are going around in circles" (News & Views 283, 248; 1980) C.B. Lucas notes that recent advances in sources of polarized electrons should provide insights into fields as diverse as neutral currents, surface physics, and molecular optical activity. He calls attention to recent developments in atomic physics-based polarized electron sources and to the fact that beams of electrons and positrons become polarized as they circulate in a storage ring. We would like to describe some very recent advances that have been made in the development and application of solid state sources of polarized electrons.

Extraction of electrons from a ferromagnetic solid offers a conceptually elegant source of polarized electrons. The electrons are aligned by an external magnetic field and exist in densities unobtainable in aligned atom beams. A very useful source has been demonstrated using field emission from a tungsten tip that has been coated with europium sulphide. At the operating temperature of 10K, the EuS is ferromagnetic and acts as a spin filter. A polarization of 0.85 is obtained at currents up to 10 nA. Most notably, the source has very high electron optical brightness and will be useful in applications requiring highly collimated, highly focused beams.

The most recently developed solid state source of polarized electrons uses photoemission from gallium arsenide. When GaAs is irradiated with circularly polarized light, the electrons excited from the maximum of the spin-orbit-split valence band may be polarized up to a theoretical value of 50%. GaAs is one of those special materials in which, by application of caesium and oxygen to the surface, the vacuum level can be lowered below the bulk conduction band minimum to produce the so-called 'negative electron affinity' emitter. Negative electron affinity GaAs is not only an extremely efficient photoemitter but the electrons can be polarized. When the light is modulated from right to left circular polarization, the direction of the polarization of the electron beam is also modulated, facilitating the use of very sensitive signal detection techniques.

A source of polarized electrons utilizing GaAs has been built which produces a continuous beam with a polarization of $\pm$43%, and a beam current of 20μA has been obtained for one milliwatt of incident circularly polarized light . A pulsed GaAs source has produced microsecond pulses of several hundred milliamperes at a 120Hz repetition rate .

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In a sense, the GaAs source is the solid state analogue of the source utilizing the 'Fano effect' in caesium discussed by Lucas. The higher density of the solid provides much more intense electron beams; typically three orders of magnitude more intense than existing Fano effect sources. The energy spread of the GaAs source is 130meV FWHM, and the effective source area is determined by the focus of the circularly polarized light, typically 0.5 mm diameter. The electron optical brightness is second only to the EuS/W field emission source.

The Fano effect in Cs can produce electron beams nearly 100% polarized. In most experiments the lower polarization of the GaAs source is easily compensated by increasing the intensity of the beam, but there are experiments, for example, where target damage is a problem, where higher polarization is required. There is hope of increasing the polarization of the GaAs source by lifting the degeneracy at the valence band maximum by (1) stressing the crystal (2) preparing epitaxially grown multilayer structures to confine the electron in one-dimensional potential wells, or by using (3) crystal field splitting in chalcopyrite semiconductors such as $CdSiAs_2$ or $CdGeP_2$, which are ternary analogues to GaAs.

The GaAs source has already been very effectively applied at SLAC to measure the parity non-conservation in inelastic scattering of 20 GeV polarized electrons from hydrogen and deuterium . It has been used to observe the surface magnetization of ferromagnetic nickel through the exchange interaction in low energy polarized electron scattering experiments. It has also been used in polarized electron diffraction studies of single crystal tungsten. The recent demonstrations of the characteristics of this type of source have led to the construction of such devices by nearly every group engaged in polarized electron scattering.

We agree completely with Lucas that there are now many exciting research opportunities because of recent advances in polarized electron sources. We believe that the new solid state source technology will play a significant part.

(Nature, 284, 5754(March 27, 1980) p. 308)

NEW TECHNOLOGIES FOR SOLAR ENERGY SILICON: COST ANALYSIS OF UCC SILANE PROCESS

By Carl L. Yaws et al.

(Abstract)

New technologies for producing polysilicon are being developed to provide lower cost material for solar cells which convert sunlight into electricity. This article presents results for the UCC Silane Process (Union Carbide Corporation Silane Process). Other processes being developed will be presented in forthcoming articles.

Cost, sensitivity and profitability analysis results are presented based on a preliminary process design of a plant to produce 1000 metric tons/yr of silicon by the UCC Silane Process. The profitability results indicate a sales price of 9.88 $/Kg of silicon (1975 dollars) at a 20 per cent DCF return on investment after taxes. These results indicate good potential for meeting the 1975 LSA cost goal of $ 10 per Kg.

(Solar Energy, 22, 6 (1979) pp.547-53)

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DIRECT USE OF SOLAR ENERGY FOR WATER DESALINATION

By S.M.A. Moustafa et al.

(Abstract)

Solar energy utilization in three different types of solar desalination system is considered. The overall efficiency of a typical basin type solar desalination plant is 30 per cent or lower. The major design factors affecting energy utilization are basin temperature, condensing surface temperature and ambient air temperature. Basic reflection and thermal radiation from the evaporating surface and transparent cover are the major sources of heat energy loss in a solar still. The efficiency of a solar desalination plant can be improved by controlling radiation from the plant basin and by the reuse of the latent heat of condensation.

(Solar Energy, 22, 2(1979), p. 148-48)

THERMAL ANALYSIS OF BLACK LIQUID CYLINDRICAL PARABOLIC COLLECTOR

By B.J. Huang et al.

(Abstract)

In the present paper a simple theoretical analysis and an experiment are carried out for a modified concentrating collector which consists of a cylindrical parabolic reflector, a transparent glass tube centered along the focal line, and a highly absorbent black liquid which flows in the glass tube to directly absorb the concentrated solar beam radiation. The analytical results are presented in normalized form and proved to be in very good agreement with the experimental results.

(Solar Energy, 22, 3(1979), pp.221-24)

HEALTH AND SAFETY HAZARDS ASSOCIATED WITH SOLAR CONCENTRATION SYSTEMS

By Lawrence L. Young III

(Abstract)

This paper discusses the primary health and safety hazards associated with solar concentration systems. The limiting hazard is chorioretinal damage. This article also discusses the methodologies derived to compute the unique safety and health hazards associated with solar energy collector and receiver systems. Research in this area is continuing, especially for eye hazards, with more extensive work planned.

(Solar Energy, 22, 4(1979), pp. 329-33)

SCIENCE NEWS

Australia orders Agent Orange inquiry

THE Australian government announced last week its intention to study the effects of Agent Orange, the dioxin containing herbicide used by the US to defoliate the countryside in Vietnam. Following a compaign by community and servicemen's groups, the government has granted $2 million to survey the health of 41,000 Australian servicemen who were exposed to the chemical during the Vietnam war. In addition, the health of the families of the exposed servicemen will be studied. The study will be carried out by the Commonwealth Institute of Health of Sydney University. Veterans organisations have criticised the proposal saying that the survey will take too long to complete to prevent injury to those exposed. Mr K.G. Schultz, national secretary of the Returned Services League, said that a smaller sample would provide sufficient information about ill effects faster than the full survey. The Vietnam Veterans Action Association said it already had an overwhelming case for compensation with cases of birth defects that included missing limbs, club feet and cleft palates. (Nature, 284, 5756 (April 10,1980) p.506)

UKAEA agrees PWR cracks a hazard (Extract)

In a supplementary memorandum to the select committee on energy, the UK Atomic Energy Authority has agreed that the possibility of pressure vessel cracks constitutes an insufficiently explored hazard of pressurised water reactors according to a report in The Times. The memorandum agrees with the analysis of Sir Alan Cottrell (Nature, 28 February page 803) that cracks as long as one inch could develop without detection in the pressure vessel which could lead to a rapid uncontrollable break resulting in a complete loss of coolant accident. Development of more advanced detection techniques than were previously thought necessary is required before the American designed PWR can be used in the UK. "It is vital that the necessary development work be undertaken as a matter of urgency" the memorandum is reported as saying...

(Nature, 284, 5756 (April 10, 1980) p. 506)

Space goes on and on

New measurements reported last week seem to provide added support for the contention that the Universe will continue to expand for ever, rather than eventually change over to a contraction that would eventually reproduce the fiery conditions of the big bang. The measurements are the major preliminary results of the Einstein satellite, otherwise known as the High Energy Astronomical Observatory-2, an Earth orbiting craft equipped with an X-ray telescope that was launched last November.

What the Einstein satellite, as HEAO-2 is known, has found is unexpectedly intense X-ray emission from quasars more than 10 million light years from Earth. At a colloquium in Cambridge, Massachussetts, last week, Harvey Tananbaum of the Harvard Smithsonian Center for Astrophysics announced that the X-radiation from the distant quasars may account for a significant proportion of the widespread low-level background of X-rays that has been detected through out the heavens.

Up to now, the most popular theory to account for this background has involved the presence of extremely hot gas, invisible except through X-ray emission that pervaded all of space. If it existed, such gas would provide much of the "missing mass," necessary to close the Universe, but gravitationally pulling back its outer reaches and therefore causing the expansion eventually to halt. But the pinpointing of the intense X-radiation from quasars suggests that there just isn't enough hidden mass in the form of gas to hold the Universe from external expansion. The closed Universe isn't dead yet, but the evidence against it is plainly piling up.

(New Scientist, 82, 1149 (April 5, 1979) p.4)

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US company increases production ten-fold

THE US drug company G D Searle & Co announced last week that it plans to increase its fibroblast interferon production "six to tenfold" by the middle of 1981. Facilities are also being set aside for conjectured production by genetically engineered Escherichia coli. A new plant will be built at Searle's High Wycombe, UK, Factory...

"But this project is purely for research and development", says Searle's director of research and biological development at High Wycombe, Dr Brian Richards. "It will cost us £6.75 million, and we don't intend to make a profit out of it".

Searle's increased fibroblast interferon production will be supplied to the Anderson Hospital of the University of Texas for clinical tests of the drug in cancer control. The trial has been designed to match an earlier one with leukocyte interferon; it is the first on cancer patients with interferon from fibroblasts, although there has been a successful trial on patients suffering from herpes keratitis of the eye (where the application was external). The difference between fibroblast and leukocyte interferon is not just that they come from different kinds of cells. By several laboratory criteria they also differ in structure. What is not yet clear is whether this will affect their therapeutic value.

Two-thirds of the space in the new plant will be set aside on a conjecture: that within 18 months strains of genetically engineered Escherichia coli will exist which can compete with fibroblasts in interferon production.

"Charles Weissmann in Zurich has produced E. coli which manufacture one or two molecules of interferon per cell," says Dr Richards. "I'm quite satisfied he has the right gene product, but the problems are going to come in trying to improve the efficiency."

Searle has in fact constructed bacteria carrying other genes that are expressed with high efficiency - "we have cells producing haemagglutinin at 1% of total protein of the cell" says Richards. Enough is not yet known about expression efficiency to predict whether such bacteria containing the interferon gene in place of the haemagglutinin gene, would be equally efficient, but apparently it gives "cause for hope".

Searle's current interferon production is roughly one quarter of world production, including leukocyte interferon, he estimates. So with the increased fibroblast production alone, world interferon production will increase two or three-fold. "Ultimately costs might fall by a factor of 100 to 1000", Richards estimates. Interferon costs would then be on a par with those of antibiotics.

(Nature, 284, 5752(March 13, 1980) p.115)

Third World now dominates leather work

(Extract)

...Today, developing countries have a large capacity for tanning hides and producing shoes and other articles, which they export to industralized countries.

Whereas, over a time span of 13 years, leather and raw hide exports from developing countries have remained stable, leather and shoe exports have soared, with increases of 594 percent and 548 percent respectively. The important difference in qualitative terms is that instead of solely exporting the raw materials, they now also export their work.

(Ceres, 12, 2(March/April, 1979) p. 11)

Mud silos ease storage problems in rural China

(Extracts)

Its raw materials consist of mud and straw, and its inventors are the peasants of northeast China...

... A foundation 1 m thick is laid in rock and cement (the only time during construction that this material is used), for protection against dampness and rodents. Work then begins on the walls, which consist of a mixture of mud and of either rice or millet straw, 25 cm thick. Work progresses in stages of 20 cm; when this height is reached, the wall is left to dry for a day or two; otherwise, it would collapse under its own weight. The practice is to erect several silos at a time, so that while the wall of one is drying, work can begin on another. When construction is completed, the silo is roofed with boards, straw, reeds or other waterproof materials. A wooden chute is, of course, placed at the base for discharging the grain. The silo's inside walls are lined with lime, and a few holes are made, for taking grain samples.

(Ceres, 12, 2(March/April, 1979), p.11)

Japan produces enriched uranium

THE Japanese government announced on 26 December that it had produced enriched uranium from its own factories. Previously, Japan has relied on the US for its supplies of enriched nuclear fuel. A factory in Ningytoge in the western part of the country has produced 300 kg of uranium with a 3.2% concentration of ^{235}U the fissionable isotope of uranium. (^{235}U has a natural abundance of 0.72%). By 1981 the country is expected to produce 50 tonnes of enriched fuel annually. The uranium will be used to fuel Japan's rapidly expanding nuclear programme which envisages the construction of an additional 15 power plants in the next five years, a doubling of present capacity. Enriched uranium at this level can also be used to construct fission bombs.

(Nature, 283, 5743 (January 10, 1980) p.121)

Dynamical test of the law of gravitation

By Hiromasa Hirakawa et al.

(Summary)

Although well established in the realm of celestial mechanics, gravitation between two masses has not yet been thoroughly examined in a laboratory. There have been several tests of the interaction since the Cavendish's celebrated experiment , most of them measuring the static attraction between two spherical masses at a distance R less than 0.8 m. The gravitational interaction is weak and, in contrast with the electromagnetic interaction, there is no effective means to shield it. It has therefore proved difficult to increase the distance R over 1 m. Under the circumstances several authors have noted that the existing experimental data do not exclude a possible term which is added to the newtonian $1/R$ potential. Meanwhile, on the grounds of elementary particle physics, a number of theoretical papers have been published predicting additional terms which vanish rapidly at R = . We now report a test of the law of gravitation in a range of R up to 4.2 m. The experiment is based on a low frequency dynamical quadrupole-quadrupole interaction between two masses, which was first observed by Sinsky and Weber . Our result agrees with the inverse square law within the accuracy of the experiment.

(Nature, 283, 5743 (January 10, 1980) pp.184-85)

Stanford announces new centre for electronics

THE University of Stanford has announced plans for a new Center for Integrated Systems, bringing together in a single research laboratory individuals with experience in physics, materials science, electrical engineering and computer research to work on very large scale integrated systems (VLSI) for industry and business management.

"Our goal is to make Stanford the premier centre in the world for VLSI research" said Dr James F Gibbons, professor of electrical engineering, in announcing plans for the $15 million centre.

The three goals of the new centre are: to produce approximately 100 MSc and 300 PhD graduates per year ("tommorrow's technological leaders" according to Professor James Meindl); to promote research, including the development of working design automation capability and computer-managed fabrication facilities; and to offer, via instructional television and videotapes, new courses, conference and workshops "designed to keep scientists and engineers now employed in industry abreast of rapid developments in the field." Funding will come principally from government and industry sources.

(Nature, 284, 5751 (March 6,1980) p.6)

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